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DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

Kuala Lumpur.

PRICE $2

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EDITORIAL

Padi Land Ownership in Krian. The recent appointment of an Agricultural Economist to the staff of the Department has resulted in an article on the economics of padi land ownership in a Perak mukim. Mr. Wilson describes the structure and development of land ownership in Tanjong Piandang, Krian which has a population of 689 persons per square mile. Most of the land titles were granted about fifty years ago, the Krian Irrigation Scheme being opened in 1906. The original size of each lot was just over seven acres but today it averages only 2½ acers per individual owner. The figure of land owners shows a rise of nearly 160 per cent. with 238 owners for every 100 lots. The various problems of plural ownership and the effect of mortgaging are also dealt with.

Soil Survey, Federal Experi Station, Serdang. The first of a proposed series of soil survey reports deals with the Federal Experiment Settion, Serdang. Three geological formations occur in the area, the main valley being recent alluvium and the remainder either Carboniferous or Triassic sedimentaries. Descriptions and analyses of the five soil series represented are given in Mr. Panton's paper which is provided with a soil map.

Transport Methods in Padi Areas. The transport of threshed padi from the field to the mill is always a problem for the padi planter where paths and proper roads are but poorly represented in his immediate vicinity. In Mr. Haynes' article the various transport methods are discussed and the bicycle is seen as likely to remain the most important. Two-wheeled carts, either hand or buffalo-drawn are able to carry respectively four or eight sacks of grain and greatly increase the carrying capacity without much capital expenditure. The less familiar *anur* or buffalo sledge, which is illustrated, can carry two or three sacks but if wheels are substituted for the sledge-runners, up to six sacks can then be carried. The transport of winnowed padi is more usual than grain collection in the field. In areas where buffaloes are not common, the use of tractors, trailers, tractor-mounted jib transporters or transport boxes offer distinct possibilities. Trials with mechanical wheel-barrows, however, were not encouraging.

Storage of Under-Milled Rice. The results of an experiment begun in 1939/40 on storing lightly-milled rice are given in a paper originally prepared by Mr. Jagoe for publication at the end of 1941.

The experiment was carried out only on a small scale, but the results emphasise the importance of factors conducive of low relative humidity in any conditions of grain storage, and of the precations which would have to be taken in any scheme for silo storage of grain, particularly in a wet tropical climate.

Conservation of food is almost as important as production, and as all factors involved in the good storage of rice in tropical climate are not yet fully understood, the publication of this pre-war experiment and the results obtained may well prove a useful record.

Seed Treatment for Fungi on Rice. Dr. Cherewick's paper deals firstly with the difference in the degree of contamination by various fungi on unsterilised and surface-sterilised rice seeds. Subsequent laboratory tests show that using an organic mercury seed disinfectant it should be possible to dress a bushel of seed for less than ten cents. This would enable transplanted padi seedlings to be disinfected at a cost of only three cents per acre.

An editorial apology is due for the late publication of this number which it had been hoped to bring out in September. Due however, to the printers taking on work for the Federal elections, there was considerable delay in the return of proofs resulting in much delayed publication.

CESSATION OF PUBLICTION

Publication of the *Malayan Agricultural Statistics* in the Economic Series will be discontinued. The issue Number 15 for the year 1949, published in 1951, will therefore be the final number in this Series.

SOME ECONOMIC ASPECTS OF PADI-LAND OWNERSHIP IN KRIAN

BY

T. B. WILSON,

Agricultural Economist.

Introduction.

This paper is one of a series describing the type of land tenure, and its influence upon agricultural organisation and efficiency, in the Krian District of Perak, the first district in Malaya in which a large scale drainage and irrigation scheme was constructed in connection with the cultivation of padi. This paper describes particularly the structure and development of land ownership in Tanjong Piandang *mukim* (an administrative unit), stretching inland from the coast for over four miles, and classified by reason of its fertility of soil as first class padi land.

Krian is one of the most densely populated areas in the Federation: 98,588 persons in 331 square miles, i.e. 298 persons per square mile (1947 Census figures). This represents an increase since 1931 of 20 per cent, overall and 35 per cent. among the Malays and Malaysians. Tanjong Piandang is the second most densely populated *mukim* in Krian with 689 persons per square mile, 71 per cent of whom are Malays. It is typical in many features of the seven other *mukims*. Most of the land titles were granted before or just after 1900.

History.

Padi had been cultivated for a long time in the more fertile parts of Krian District, and padi lands in the Parit Buntar and the Coastal mukims of Bagan Tiang, Tanjong Piandang, and Kuala Kurau were growing good crops of padi in favourable seasons long before the irrigation scheme was constructed. Nevertheless, lack of regular water supply discouraged improvement of cultivation and settlement.

At some time prior to the British Administration, the Mentri of Larut caused a ditch 8½ miles long to be dug from the Krian River (at a point four miles upstream from Parit Buntar) to Bagan Tiang to supply water to the more fertile and more important padi growing areas of the district, but it was not large enough. In 1880, the original Mentri ditch was widened and deepened by the State Engineer, Perak to allow a larger amount of water to be sent down at spring tides. Settlers were encouraged to clear the jungle and received confirmation of title to the land after two or three years of cultivation. Between 1882 and 1892, the padi area averaged 32,000 acres, in addition to the sugar land which was later planted with rubber.

The Perak Census of 1879 enumerated in Krian 7,650 persons and 24,698 persons in 1891. These figures exaggerated the true population increase since the 1891 Census was taken during the padi season and included many non-residents. Population growth took the form mainly of nett immigation from other districts and from Java and Sumatra; the sex ratio of almost two men to one woman indicates a disproportion usual to pioneer settlements. But the deterrent to permanent settlement was the uncertainty of the rain-water supply, causing epidemics and about once in every four years reducing the effective padi area and yields.

To overcome these difficulties, an irrigation system was proposed, largely based on Indian experience. In 1906, the Krian Irrigation Works at Bukit Merah were officially opened and, with more recent extensions at Sungei Acheh and South Krian, now supply 77,000 acres. Water rates were imposed, with the intention of securing a net return of 15¾ per cent. on capital invested.

Krian was first settled over a long period, then drained and irrigated thus attracting further settlement. This distinguishes the area from those of Sungei Manik and Tanjong Karang where the large-scale irrigation schemes were planned *ab initio* as the irrigation of reclaimed land for later colonisation. Many of the features of the older Krian District, however, offered and still offer invaluable indications of the desirability of certain probable forms of development of the later schemes. This is particularly true of land tenure.

Tanjong Piandang Mukim how totals 9,960 acres, just over half (4,810 acres) having been declared a Malay Reservation in 1937, and the rest in 1951. Originally declared an Irrigated Area by Gazette Notification in 1915, it received in 1938 to 1939 and 1953 extra land at the expense of the mangrove swamps on the sea coast which has an appreciable, though uneven, rate of annual accretion. Land was surveyed, given lot numbers for identification and the details registered by the "Torrens" system. The *Mukim* Register records 2,153 entries at 13th December, 1953, but owing to cancellations and continuations these contain over 28 per cent duplicates and the number of actual titles is 1,540.

Type and Age of Land Titles.

One title in every ten is for kampong land and these titles account for less than two per cent of the land. The rest of the land was at the time specifically granted for the cultivation of wet padi, or later by Gazette Notification of Irrigation Area announced to be so granted, thus superseding any other specified cultication e.g. "economic trees", made originally by the Land Officer under the Land Code. The majority of the cultivators live on the padi lots, a small area next to the access path being raised for a house site, food crops and poultry rearing. The padi-land titles fall into two distinct groups—those (about 11 per cent.) issued less than one generation ago in 1938 to 1939, and the rest issued about 1900.

Size of Padi-Land Lots.

The original lots averaged just over seven acres (Table I), but lots varied in size considerably from the mean (Table IV).

Table I.
Comparison of Average Size of Padi-Land, 1900 and 1954.

	Acreage per Lot			Acreage per Share.		
	Acr.	Rd.	Pol.	Acr.	Rd.	Pol.
Two generations ago	7	0	35	6	3	13
1954	6	1	04	2	2	21

There was initially no shortage of uncleared jungle land and lots were granted in sizes as applied for depending on the ambition or industry of the applicant and his family. Later, narrow strips of land were resumed by Government for Canal Reserves to permit the construction of a system of water control. By contrast, the Sungei Manik and Tanjong Karang Schemes followed the lay-out plans produced by the Drainage and Irrigation Department, newly created in 1932, the plans consisting of padi lots of predetermined size and shape.

As a result, in these schemes the padi lots were granted in uniform size according to Government policy [1].

The position in 1954 shows a reduction in lot size. Over the two generations, approximately 13 per cent. of the original lots have been subdivided and 7 per cent. of these subdivisions have been re-subdivided. On the same area of land, the number of lots has increased by 15 per cent. and consequently the average size has fallen to 6¼ acres. Greater significance lies in the change in the number of owners.

Number of Owners.

Most of the land titles were taken out originally by one person as sole owner. As only six out of every 100 lots were taken out by co-owners and as no lot was shared by more than two co-owners, there were, on average, 106 land owners or co-owners for every 100 lots, (Table II). Consequently, the average size of each owners or co-owners individual share (6¾ acres) was only slightly less than the average size of each lot. In 1900 these shared lots tended to be considerably larger than average, so the average share of each co-owner (5 acres, 12 poles) tended to be almost as large as the unshared lots of sole owners.

By 1954 the number of owners has risen spectacularly by 159 per cent; there are an average of 238 owners or co-owners for every 100 lots. The average size of share of each individual owner or co-owner has dropped to 2½ acres.

NOTE 1. Owing to policy changes, Sungei Manik Scheme now contains lots in 4 different sizes: 3 acres, including house lot; 4 acres, including house lot; 4 acres excluding house lot on tied titles; and 6 acres exclusive of 2 acres for house and other crops. Tanjong Karang lots have mostly been granted in 3 acre sizes excluding separate house lots.

Table II.

Extent of Co-Ownership, 1900.

No. of Owners.	% of Lots.	% of Owners.	% of Land.
1	94	89	92
2	6	11	8
	100	100	100

Co-Ownership.

"Co-ownership" exists where a lot is owned by more than one person, each individual co-owner possessing an "undivided share" in the land. For example, an undivided one-third share of a lot is not separated on the Torrens system from the other two "one-thirds" in that lot, either in the survey sheets or in the Mukim Register. The three owners are legally co-owners of all the land, all acting jointly in transactions which affect that lot and all entitled to one-third of all the produce of the land. In practice, they agree on separate internal boundaries and each enjoys that one-third of the lot as if he had a separate title to it, individually cultivating, transferring, transmitting, devising, renting or charging his undivided share.

Co-ownership now predominates by any criterion; the majority of the land area, of the lots, and of the owners is subject to co-ownership (Table III). Originally only one owner in ten shared, but now four out of every five are co-owners. It is obviously much more usual to partition land by sharing lots (although this is not strictly in accordance with the Muslim law of inheritance, which requires the division of the estate), than by subdivision into separate, officially surveyed lots, which is expensive. Between 1900 and 1954 this practice has affected the size of the padi-land owned (Table IV). In 1900, 54 per cent. of the shares were over five acres in size, but now only nine per cent. are. Similarly, only two per cent. of the shares were originally less than two acres in size; now it is 53 per cent.

The system of undivided shares may be harmless when co-owners belong to one family, are on good terms and resident locally, otherwise it is liable to hinder both cultivation and transfer of land. Absentee owners of small fractions, e.g. 1/120 or 1/44 of a lot may abandon this land when padi prices are low, causing increased incidence of pests and diseases in nearby cultivated areas, and they may make more difficult the selling of the whole lot with a clean title. Shared land tends to be less negotiable and less valuable than unshared, especially if a caveat lies against the share of a minor. This differential value has obviously been insufficient to prevent fragmentation, but it may be retarding it.

Table III.

Extent of Co-Ownership, 1954.

No. of Owners.	% of Lots.	% of Owners.	% of Land
1	48	20	39
2	18	15	18
3	15	19	20
4	8	14	12
5	7	14	6
6 and below 10	3	10	3
10 and over	1	8	2
	100	100	100

Table IV.

Comparison of Percentage Distribution by Size of the same Padi Land, 1900 and 1954.

Size Group.	1900		1954	
	% of Lots.	% of Shares.	% of Lots.	% of Shares.
Below 1 acre	—	—	—	24
1 and below 2	2	2	3	29
2 „ „ 3	7	7	8	15
3 „ „ 4	11	14	13	10
4 „ „ 5	21	23	28	13
5 „ „ 6	9	9	11	2
6 „ „ 7	6	4	5	3
7 „ „ 8	8	11	5	—
8 „ „ 9	9	9	8	—
9 „ „ 10	11	9	8	1
10 „ „ 15	10	7	8	3
15 and over	6	5	2	—
	100	100	100	100

Fragmentation.

Fragmentation, either as the official subdivision or as the undivided sharing of padi lots, has arisen in two ways either by inhertitance or by sale. Muslim laws of distribution on death are more easily complied with in Arabia, where the bulk of the property is in the form of camels or jewels. In Malaya almost all the property at death is land, and only rarely is any other asset, moveable or immovable, declared in Krian.

In Krian, instances of distribution usually take the form of Muslim fractional shares to each beneficiary—a very elaborate system providing a fraction of the estate inproportion to the relationship of the claimants to the deceased, e.g. widow ¼ share if no children, ⅛ share against children; sons taking twice the share of daughters, etc. Very occasionally a beneficiary, usually female, may relinquish her claim to her Muslim fraction. When the estate of the deceased consists of more than one lot, an opportunity occurs to divide the estate by the lots into the appropriate fractions (Example "A").

Example A.

Estate consisting of 6 lots:

Transmission Presentation No. 7441, 1953.
Deceased: Chick/Chek/Dok binte Ali (alias Alil)
Bagan Serai Mukim:

E.M.R. *	Share of Deceased.	Name of Beneficiary.	Share of Beneficiary.
6796	½	Mat Amin b. Hj. Ibrahim	½
7596	All	Nah bte. Hj. Ibrahim Jah bte. Hj. Ibrahim	Equal shares.
4457	All	Mat Amin b. Hj. Ibrahim	All
5070	⅛		⅛
4468	⅛	Mat Amin b. Hj. Ibrahim	⅛
4467	⅛		⅛

In this example, fragmentation is only a slow process: previously there were six lots or shares, now there are seven. This opportunity is taken on only one out of three occasions when it arises. More usually, owing to real or imaginary differential values of the individual lots, the larger estates containing several lots are subject to rapid fragmentation on distribution (Example B). A small degree of fragmentation also occurs when the property is transmitted before the death of the owner by a trust deed or a transfer for "love and affection" to the immediate relatives.

Most of the transactions relating to land are transfers by sale. Fragmentation by sale (i.e. more co-owners buying than co-owners selling the same lot or share) is twice as common as consolidation by sale (i.e. more co-sellers than co-buyers). By 1954 the same lot may have been subject to several forms of fragmentation.

* Entry in Mukim Register (for each lot).

Example B.
Estate consisting of Two Lots.

Transmission Presentation No. 7515, 1954.
Deceased: Saerah binte Hj. Saaludin (alias Saharah bte. Hj. Sahaludin)
Mukim: Bagan Serai.

E.M.R.		Share of De'cd.	Name of Beneficiary.	Share of Beneficiary.	
				Lot (a)	Lot (b)
(a)	1735	All	Hj. Halijah bte. Anul	1/7	1/56
(b)	1814	⅛	Jamiah bte. Anul	1/7	1/56
			Hamidah bte. Anul	1/7	1/56
			Lokman b. Anul	2/7	2/56
			Tora b. Hussin	2/7	2/56

Size, Efficiency and Fragmentation.

There have obviously been many factors, economic, social and religious, which have affected the subsequent development of these lots since 1900. One of the more important factors determining the course of this development, may be the size of the original lot. Tables V and VI indicate that 76 per cent. of those lots which remained in one ownership were originally below five acres, in comparison with 21 per cent. of those later under co-ownership. Similarly, only 16 per cent. were over seven acres, whilst of those which later had several owners, some six per cent. were at least seven acres in size. There is apparently a close relationship between fragmentation and granting of land in lots too large or too small for efficient farming under prevailing systems. The pressure to partition may act most strongly on these lots, and there may be some which may beneficially be partitioned. For the most part in Krian the forces which tend towards fragmentation, e.g. pressure of population, laws of inheritance, etc., have overcome the economic forces which might tend to stabilise holdings at their most efficient size under customary methods of cultivation.

Table V.
Size of Lots and Partition.

Original Size in Acres.	% of each Size Group which: (a) Remained whole.	(b) Became shared.	All.
Below 3	100	—	100
3 and below 5	66	34	100
5 and below 10	16	84	100
10 and above	28	62	100

Table VI.

Percentage Size Distribution in 1900 of Lots which have since become or remained (a) in sole ownership, (b) in co-ownership.

Single Ownership.	Co-Ownership.	Size Group Acres.
1 and below 2	4	—
2 „ „ 3	16	—
3 „ „ 4	24	6
4 „ „ 5	32	15
5 „ „ 6	4	12
6 „ „ 7	4	3
7 „ „ 8	—	18
8 „ „ 9	—	15
9 „ „ 10	8	13
10 „ „ 15	8	9
15 and over	—	9
All	100%	100%

Continuity of Ownership.

In the last 50 years most lots of land have changed hands in part or in whole several times (Table VII). The reason for the change of ownership is not always distribution on death. In fact, distribution on death accounts for only one quarter of the changes—the other three-quarters are "transfers of ownership by sale" or much less frequently for "love and affection" or by "deed of trust". This has to some extent retarded further fragmentation as more than half of the lots have not remained wholly or even partly in the ownership of the same family over the 50 years. This can result in a number of a largely unrelated co-owners on a relatively small area of land. (Example C).

Table VII.

Percentage Distribution of Lots by Number of Changes of Title in whole or in part.

No. of Changes.	% of Lots.	No. of Changes. (con'td)	% of Lots.
Nil	3	7	8
1	5	8	3
2	12	9	3
3	18	10	3
4	12	11	3
5	18	12	2
6	10		100%

Average number of changes of title = 4.8 per lot.
Average number of transmissions on death = 1.2 per lot.

Example C.

Mukim: Tanjong Piandang. E.M.R. 841.
Total Acreage: 3 Acres, 0 Roods, 07 Poles.

Date.	Type of Transaction.	New Owner or Co-Owner(s).	Share.
1897	Original grant	Mat Hussin b. Abdullah	Whole.
1920	Transfer for "love and affection"	Talib b. Mat Hussin	1/2
		Sampol b. Mat Hussin	1/2
1926	Transfer by sale of Talib's half share	Hj. Mohair b. Ponttar	1/2
1935	Transmission on death of Sampol b. Mat Hussin	Mat Shariff b. Sampol	1/12
		Mat Hassan b. Sampol	1/12
		Mat Hashim b. Sampol	1/12
		Kamariah bte. Sampol	1/24
		Saiah bte. Sampol	1/24
		Mat Hassan b. Sampol (as Guardian)	4/24
1940	Transmission on death of Hj. Mohair b. Ponttar	Hj. Abdul Rani b. Hj. Mohair	4/10
		Zawiah bte. Hj. Mohair	1/10
1950	Transfer by sale of 1/12 share of Mat Hashim	Meah bte. Mat Saman	1/12

Present Owners:	Share.	Ac.	Rd.	Pl.
Mat Shariff b. Sampol	1/12	0	1	00
Hassan b. Sampol	1/12	0	1	00
Kamariah bte. Sampol	1/24	0	0	20
Saiah bte. Sampol	1/24	0	0	20
Hashim b. Sampol (as Guardian)	4/24	0	2	01
Hj. Abdul Rani b. Hj. Mohair	4/10	1	0	35
Zawaiah bte. Hj. Mohair	1/10	0	1	09
Meah bte. Mat Saman	1/12	0	1	00

The lot in Example C has been subject to a normal degree of fragmentation by inheritance and it should be noted that the last transmissions took place 15 and 20 years ago. Five of the final co-owners are relatives of the original owner but they own only 5/12 of the acreage. There are now three different families as co-owners of the lot.

Charging.

Land titles are customary collateral for large or long-term credit in peasant areas. Probably not all the transactions, however, have been registered at the Land Office as charges against the land. The *Mukim* Registers show that 39 per cent of the lots have been "charged" over the 50 years, some lots more than once, (Table VIII). The charge was satisfied by the sale of the land in the case of over one third of the charges and over half of the lots which were charged.

Table VIII.

Distribution of Padi-Land Lots by Number of Times charged.

Time Charged.	% of Lots.
Nil	61
1	22
2	12
3	4
4 and over	1
	100%

In some cases the condition attached to the loan may have been onerous or the loan may have been used unproductively, so that repayment was impossible. The rates of interest normal to South-East Asian agricultural loans are naturally high, and where legislation attempts deliberately to restrict them, some interest on the lenders' capital has probably taken the form of the price difference between the surrendered pledge value and the open market resale value of the charged land.

As a result of the 1913 and 1933 Malay Reservation Enactments it is now almost impossible for the non-Malay to lend money on the security of a Malay's land in Tanjong Piandang, which in 1937 and 1951 was a Gazetted Malay Reservation. New types of loans, e.g. from Government, Rural and Industrial Development Authority or Co-operative Societies, do not equal the amounts previously loaned by professional money-lenders. In Tanjong Piandang loans of the new type affect only 0.3 per cent. of the lots and 0.2 per cent. of the acreage, whilst undischarged money-lenders' loans of the old type still remain on three per cent. of the acreage. It is possible that loans against the collateral of the padi crop have increased since the Malay Reservation Enactment. There is a strong connection between land tenure and agricultural credit.

Conclusion.

The present average size of individual share of 2½ acres obviously does not permit full-time owner-cultivation at tolerable standards of living. Other types of tenure systems must be in operation, and the units in which padi-land is owned may bear little relation to the units in which it is cultivated. Other land may be owned[2], shares may be rented in or rented out—these and other features must form the basis of further study. For the present it is sufficient to note that freehold ownership as a method of land tenure in a Muslim South-East Asian country is, of itself, no guarantee of a "healthy system of peasant proprietors."

Note 2. The present method of recording in Land Offices in Malaya makes it practicable to trace only all the owners of each lot, and not all the lots of each owner.

Summary.

This paper describes the present structure of land ownership, e.g. type and style of title, size of share, number of owners, extent and effect of co-ownership and high turn-over of owners, especially when the land has been charged. It compares this with the position in 1900 and indicates the process of development. The economic significance of these factors has been indicated explicitly where necessary.

Acknowledgements.

The information is mainly based on Land Office Records, using a random sample of Entries in the *Mukim* Registers and making allowance for duplication. The Krian Office records are not seriously in arrears. Acknowledgement is made for their advice and assistance to Dato Shabandar Ibrahim bin Abdul Karim, District Officer, Krian; Raja Mokhtar bin Raja Ya'acob, Assistnat District Officer (Lands) Krian and to the Land Office staff.

SOIL SURVEY REPORTS; No. 1, FEDERAL EXPERIMENT STATION, SERDANG

BY

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Geologist (Soil Survey).

Introduction.

This report has been written to accompany the soil map of the Federal Experimental Station, the field work for which was carried out in September, 1953. The method of survey consisted of examination of soil profiles in five foot pits dug in selected areas where the greatest differences in soil types could be expected, followed by plotting of the various soil type boundaries which were recognised in the field by testing with a three foot auger. Three of the soil series identified were first described by Owen (1) in his "Provisional Classification of Malayan Soils", and two series, one of which has not yet been named, are here described for the first time. The original Kedah series of Owen's "Provisional Classification" has been found to cover a very wide field, and is here restricted to allow for the inclusion of the Serdang series. Although this may appear confusing, it is a necessary step resulting from detailed survey. Such subdivision of the larger soil series, which is normally brought about by restricting the original broad description, is a complication which inevitably results from systematic mapping.

A knowledge of the soil-forming factors at work in any area is a prerequisite for the true understanding of a soil, its uses and limitations, and each of these factors as they exist at Serdang is treated separately in the following paragraphs.

Soil-Forming Factors.

(1), *Climate.* As is the case over most of Malaya, the humidity is high, while the temperature rises into the 90's on most days of the year. Nights are generally cool with normal minimum temperatures in the low 70's. The sun shines for six or seven hours almost every day while strong winds are rare. The rainfall is the most variable factor and while the climate is generally moist throughout the year, analysis of the rainfall data shows that, almost every other year, Serdang is subject to a short dry season in which there is at least one month when the rainfall is less than 2.4 inches. This is important from the agricultural point of view, because during such months the evaporation from the soil is likely to exceed the rainfall with consequent drying out of the surface horizons.

(2), *Geology.* The three geological formations outcropping within the station boundary are the Recent Alluvium in the main valley, the

FEDERAL EXPERIMENT STATION, SERDANG.
SOIL SURVEY – W. P. PANTON

Numerals denote field numbers; ..... field boundaries.

Roads ———

Triassic Sedimentary Group forming the hills on the western side, and the Carboniferous Sedimentary Group which gives rise to a small area of undulating ground in the south-east corner.

The Recent Sediments consist of a mixture of fine sands, silts and clays underlain by coarser sand and gravels which are often tin-bearing. Two soil series derived from this parent material are recognised, one of the series being subdivided into two types, based on slight textural variations in the surface horizons. The commonest type is the Perak silty clay loam.

The Triassic Sedimentary rocks are made up chiefly of conglomerates and quartzites, the later rock being generally weathered to a soft sandstone when seen in field exposures. Two soil series have been identified over these rocks viz. the Kedah and Serdang sandy loams.

Finally, the Carboniferous Sedimentary rocks probably consist of calcareous phyllites although no fresh exposures can be seen in the field. One soil series is developed over this rock, the Malacca clay loam.

(3), *Time.* The time factor which has operated on these soils is rather variable. Judging from the pronounced laterite horizon and its occurrence over low undulating land just above the level of the recent alluvial plain the oldest soil is probably that formed from carboniferous sediments. The heavier soils of the valley bottom are probably of intermediate age, and the youngest are those developed from Triassic sediments where constant erosion and soil creep is preventing the soils from developing much beyond the juvenile stage.

(4), *Topography.* The topography is strongly influenced by the geology, the Triassic rocks giving rise to the forested hills of the Serdang Jungle Reserve in which several hills reach a height of over 450 feet. The whole of this area is deeply dissected and many of the hills are very steep-sided. The smaller valleys are often streamless and narrow but occasionally broaden out to give gently undulating flats up to several acres in extent. On the eastern edge of this hill region the foothills slope gradually into the main Serdang valley.

The alluvial area on the eastern side of the station is generally flat, or very slightly undulating, and drainage in poor throughout. One very low ridge runs out from a foothill of the Triassic range and divides the alluvial region into two approximately equal-sized portions. In the south-east corner an undulating area marks the position of a small Carboniferous outcrop.

Subsoil drainage in the hills is extremely good and streams are not common; on the valley flats the opposite is the case, waterlogging being a common feature in these more compact, heavier-textured soils, and artificial drainage ditches are numerous.

(5), *Vegetation.* The natural vegetation of the freer-draining hill soils was a type of lowland Dipterocarp rain forest similar to that found in parts of the Jungle Reserve at the present day, while the soils on the flatter part of the Station probably supported a swamp forest flora.

Soils.

Descriptions of the five soil series which have been identified are given in the following paragraphs together with a typical set of results of analyses of soil samples from a pit dug in each series. The routine methods used are mechanical analysis by Bouyoucos hydrometer; pH (glass electrode); carbon by Walkley-Black; nitrogen by macro-Kjeldahl; available phosphate by extraction with ammonium fluoride and hydrochloric acid solution at pH 1.8 followed by colorimeteric estimation; and available potash by extraction in N/2 acetic acid (ratio 10 gms. soil : 100 mls. soln.) followed by estimation in the Lange flame photometer.

(A) Soils derived from Triassic Parent Material.

(1), KEDAH SANDY LOAM.

This soil, developed from quartzitic or conglomeritic parent material, occurs on the tops and upper slopes of the hills on the western edge of the station. It is a shallow soil which is often subject to considerable erosion and soil creep even under its natural forest cover.

The topsoil is thin and consists of up to six inches of dark brown, or brown, well-structured and well-drained, sandy loam overlying up to 18 inches of light brown, sandy loam possessing a weaker crumb structure and with a noticeably reduced number of roots. Below this horizon the soil becomes more compact and harder to dig and the parent material is usually found at a depth of about three feet. The typical colour at this level is yellowish-red and the horizon is made up of partially-weathered fragments of quartzite or conglomerate in a matrix of coarse sandy or gravelly loam. Tree roots practically disappear at this depth and the main rooting zone is restricted to the top two feet of the profile.

Table I.

Analysis of Kedah Sandy Loam Profile (Field 44C), Ref. R.9811.
(a) Mechanical Analyses.

Depth in inches.	Percentage.						pH
	Clay < .005 mm.	Silt .005 — .05 mm.	Fine sand .05 — .5 mm.	Coarse sand .5 — 1 mm.	Gravel 1 — 2 mm.	Stone in orig. > 10 mm.	
0 — 6	12	37	26	24	1	Nil	5.1
6 — 14	14	33	30	22	1	,,	5.2
14 — 24	18	35	22	21	4	5	5.4
24 — 31	25	24	15	22	14	39	5.4
31 — 42	27	16	17	20	20	34	5.4
12 — 57	22	16	20	22	20	34	5.5

(b) Chemical Analyses.

Depth in inches.	Percentage.				C/N ratio.	Available nutrients.	
	Loss on Ign.	Organic Matter.	C.	N.		P_2O_5 p.p.m.	K_2O p.p.m.
0 — 6	7	2.48	1.44	0.112	12.9	10	35
6 — 14	5	1.03	0.60	0.070	8.6	6	50
14 — 24	4	0.57	0.33	0.034	9.7	3	30
24 — 31	5	0.41	0.24	0.028	8.6	2	25
31 — 42	5	—	—	—	—	—	5
42 — 57	5	—	—	—	—	1.5	5

Fertility is rather poor owing to the low nutrient reserves of the parent material combined with the constant removal of the enriched upper layer by erosion. This later process is considerably accelerated when the soil is cleared of its natural forest cover, and the land is unsuitable for annual crops. Tree crops, which do not make heavy demands upon the soil are an obvious choice, and the practice of planting cocoa under jungle shade is a good example of how such soils can be utilised, although they could not be regarded as good cocoa soils.

(2), SERDANG SANDY LOAM.

This soil occurs towards the bottoms and on the shallower slopes of the Triassic hills. It is a soil which allows of deep rooting and has good subsoil drainage.

The topsoil is a well-structured dark yellowish-brown sandy loam, up to 10 inches in depth, which changes below to a brown loam of a slightly heavier texture and rather weaker crumb. This continues down to four or five feet and is underlain by a yellowish-red sandy clay loam. Even at a depth of six feet this horizon is easy to dig and still possesses a definite, although rather weak, granular crumb. The profile is well-drained throughout but is usually more moist than the Kedah sandy loam.

Roots penetrate to much greater depths and soil creep and wash from the hillsides result in constant additions to the topsoil, thus increasing its nutrient status at the expense of the Kedah series soil which is developed at higher levels. Higher organic matter content, greater root room and improved structure all help to make this a more fertile soil even though it is derived from the same parent material. It can be used for annual cropping provided simple conservation measures are practised. All phases appear to be suitable for tree crops.

Table II.

Analysis of Serdang Sandy Loam Profile (Field 44b), Ref. R. 9812.

(a) Mechanical Analyses.

Depth in inches.	Percentage. Clay < .005 mm.	Silt .005 — .05 mm.	Fine sand .05 — .5 mm.	Coarse sand .5 — 1 mm.	Gravel 1 — 2 mm.	Stone in orig. > 10 mm.	pH
0 — 2	12	24	27	36	1	Nil	5.7
2 — 5	12	24	25	37	2	,,	5.6
5 — 14	18	23	28	29	2	,,	5.6
14 — 24	20	23	23	32	2	,,	5.5
24 — 35	24	24	19	31	2	,,	5.4
35 — 48	28	21	20	29	2	,,	5.4

(b) Chemical Analyses.

Depth in inches.	Percentage. Loss on Ign.	Organic Matter.	C.	N.	C/N ratio.	Available nutrients. P_2O_5 p.p.m.	K_2O p.p.m.
0 — 2	4	1.44	0.84	0.098	8.6	123	30
2 — 5	4	1.29	0.75	0.062	12.1	110	40
5 — 14	4	0.83	0.48	0.028	17.1	4	40
14 — 24	4	0.57	0.33	0.028	11.8	—	45
24 — 35	4	—	—	—	—	1.2	55
35 — 48	4	—	—	—	—	—	25

(B) Soil Derived from Carboniferous Parent Material.

(1), MALACCA CLAY LOAM.

This soil occurs on gently undulating land found in the south-east corner of the station and appears to be formed over small islands of calcareous shale or phyllite which rise above the level of the main valley floor. It is a highly laterised soil of low fertility.

The topsoil is a yellowish-red granular clay loam about three or four inches thick. It is very well structured, well drained and aerated. Below this, however, a less well-structured clay loam is found which

continues down to a depth of about 18 inches. At this level there is a sudden change to the laterite horizon consisting of small rounded concretions up to one and a half inches in diameter embedded in a matrix of red clay. This zone is often six feet or more in thickness and the concretions show an increase in size with depth. Large boulders up to three or four feet may be seen in the laterite quarries which have been dug in several places.

A combination of poor physical and chemical properties make this a soil of rather low fertility, and the growth of tree crops appears to be largely conditioned by the depth of topsoil above the laterite.

Table III.

Analysis of Malacca Clay Loam Profile (Field 40), Ref. R.9849.

(a) Mechanical Analyses.

Depth in inches.	Percentage.						pH
	Clay < .005 mm.	Silt .005 — .05 mm.	Fine sand .05 — .5 mm.	Coarse sand .5 — 1 mm.	Gravel 1 — 2 mm.	Stone in orig. > 10 mm.	
0 — 3	38	22	24	13	3	7	5.1
3 — 6	50	20	17	10	3	6	5.0
6 — 12	54	17	15	9	5	7	5.0
12 — 17	53	17	12	10	8	20	5.1
17 — 31	50	17	11	13	9	72	5.3
31 — 50	43	19	11	16	11	57	5.3

(b) Chemical Analyses.

Depth in inches.	Percentage.				C/N ratio.	Available nutrients.	
	Loss on Ign.	Organic Matter.	C.	N.		P_2O_5 p.p.m.	K_2O p.p.m.
0 — 3	14	3.15	1.83	0.154	11.9	4	65
3 — 6	13	2.59	1.50	0.129	11.6	4	50
6 — 12	13	1.50	0.87	0.090	9.7	4	50
12 — 17	12	1.38	0.80	0.073	10.9	3	55
17 — 31	12	0.88	0.51	0.64	8.0	3	65
31 — 50	11	—	—	—	—	2	55

(C), Soils Derived from Alluvial Parent Material.

(1), PERAK SILTY CLAY LOAM AND SANDY CLAY LOAM.

This series has been subdivided into two types based on textural differences in the topsoil. The profiles are closely similar, and the slightly lighter texture and better drainage of the sandy clay loam, while not immediately obvious in the field, probably helps to make this a more easily worked and slightly less unproductive soil. The silty clay loam is the more common type developed over the low-lying areas, and its profile description, which is given below, can be taken as typical of the series as a whole.

The topsoil is a greyish-brown or grey well-structured silty clay loam about six inches deep, below which the soil loses its granular structure and becomes more compact, while its colour changes to a pale grey. This generally continues down to about two feet where a darker, often blue-grey, horizon about one foot in thickness is developed which is rather compact and moist. Roots are not common at this level which appears to be a zone of permanent saturation. This is underlain by a compact whitish-grey, or white, coarse, sandy clay or gravel made up of irregular quartz fragments in a white clayey groundmass.

This soil is moderately fertile with reasonable values for nitrogen and potash, but invariably low phosphate content. The chief physical disadvantage is the high water-table, and it is generally necessary to improve the drainage by artificial means.

Table IV.

Analysis of Perak Sandy Clay Loam Profile (Field 28), Ref. R.9817.

(a) Mechanical Analyses.

Depth in inches.	Percentage.						pH
	Clay < .005 mm.	Silt .005 — .05 mm.	Fine sand .05 — .5 mm.	Coarse sand .5 — 1 mm.	Gravel 1 — 2 mm.	Stone in orig. > 10 mm.	
0 — 3	17	23	41	18	1	Nil	5.5
3 — 6	13	19	45	22	1	,,	5.7
6 — 15	17	19	45	18	1	,,	5.6
15 — 24	11	16	52	20	1	,,	5.5
24 — 30	10	21	32	36	1	,,	5.4
30 — 48	12	22	26	38	2	,,	5.3

(b) Chemical Analyses.

Depth in inches.	Percentage.				C/N ratio.	Available nutrients.	
	Loss on Ign.	Matter. Organic	C.	N.		P_2O_5 p.p.m.	K_2O p.p.m.
0 — 3	13	4.54	2.64	0.199	13.3	50	30
3 — 6	8	1.81	1.05	0.092	11.4	43	20
6 — 15	10	2.53	1.47	0.092	16.0	34	10
15 — 24	12	3.77	2.19	0.123	17.8	39	20
24 — 30	5	—	—	—	—	55	15
30 — 48	2	—	—	—	—	6	10

(2). UNNAMED BLACK SILTY LOAM AND FINE SANDY LOAM.

This series is found along the edge of the main valley where the alluvial material meets the footslopes of the Triassic range. The parent material is the same as that of the Perak series, but the higher water-table at these points results in the formation of a much poorer soil.

The topsoil is a very dark brown or black moist silty or fine loam which often has a well-developed granular crumb structure. At a depth of about six inches, this gradually changes to a more compact silty or fine sandy loam, with a greasy feel, which continues down to between three and five feet, where there is a sudden change to a white clayey sand similar to that which underlies the soil of the Perak series.

Pits dug in this soil flood rapidly and drainage is much impeded throughout the profile. The expalanation for this high water-table appears to lie in the topographic position of this soil. Situated as it is at the foot of the hill range there is a constant supply of water coming down the hillside through the freely draining subsoil of the Serdang sandy loam, and this water is help up by the impervious alluvial sediments of the plain resulting in the very high water-table and the formation of the hydromorphic black soil.

Fertility is extremely low and yields are poor even after deep ditching has been carried out in an effort to lower the water-table. From previous work on this soil, it appears that there may be a toxic effect due to high arsenic contents.

Table V.

Analysis of Unnamed Black Fine Sandy Loam (Field 9), Ref. R.9815.

(a) Mechanical Analyses.

Depth in inches.	Percentage.						pH
	Clay < .005 mm.	Silt .005 — .05 mm.	Fine sand sand .05 — .5 mm.	Coarse .5 — 1 mm.	Gravel 1 — 2 mm.	Stone in orig. > 10 mm.	
0 — 3	19	28	39	13	1	Nil	5.4
3 — 9	17	28	43	11	1	,,	5.3
9 — 24	17	22	56	5	Trace	,,	5.5
24 — 41	27	26	41	6	Trace	,,	5.5
41 — 52	18	12	32	37	1	,,	5.5

(b) Chemical Analyses.

Depth in inches.	Percentage.				C/N ratio.	Available nutrients.	
	Loss on Ign.	Organic Matter.	C.	N.		P_2O_5 p.p.m.	K_2O p.p.m.
0 — 3	12	3.66	2.13	0.193	11.0	75	83
3 — 9	12	2.99	1.74	0.160	10.9	31	45
9 — 24	12	2.63	1.53	0.115	13.3	14	50
24 — 41	13	3.30	1.92	0.118	16.3	11	40
41 — 52	—	—	—	—	—	5	10

Disturbed Land.

This includes tailings resulting from mining operations, built-up areas, and land which has been subjected to serious gully erosion in the recent past. The land disturbed by mining lies to the south of the administration buildings and includes a number of variable soils, all of which have little agricultural value. There is a similar area in the north-east corner of the station and here again the soil is rather mixed and includes clayey sands and sandy clays with patches of coarse quartz sand and occasional limestone fragments, the limestone having come from the Carboniferous bed rock which probably lies some 20 feet below the surface.

Summary.

A soil survey of the Federal Experiment Station, Serdang, has been carried out. The five soil-forming factors are discussed and descriptions of the five soil series which have been identified are given together with the results of analyses of soil samples from pits in each series.

Reference.

(1) Owen, G. (1951): "A Provisional Classification of Malayan Soils", *The Journal of Soil Science*, **2**, 20.

A PRELIMINARY SURVEY OF TRANSPORT METHODS IN PADI AREAS WITH SPECIAL REFERENCE TO THE PROBLEMS INTRODUCED BY MECHANICAL HARVESTING

BY

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Introduction.

The padi planter in the Federation of Malaya is faced with transport problems which arise from the nature of the soil, the fragmented holdings and the general lack of paths and roads. These problems have been overcome in most padi-growing districts by various means, and transport systems, usually involving many people working on the "little and often" principle, have been evolved. The trials of the Combine Harvester and mechanical threshers during the 1953-54 harvest season suggested, however, that these transport systems are finely balanced and any change in conditions, such as speeding up the harvest, can easily cause disruption. It is important, therefore, that due consideration should be given to the transport of grain before any attempt is made to replace gangs of itinerant labourers with contractor's harvesting machines, since a breakdown of the system will introduce a grave risk of damage to grain left lying in the fields or will mean that machines will have to be worked at less than their full capacity.

Padi is usually collected from the fields by hand and since the output of threshed grain is not likely to exceed 600 lb. per man day it is not unduly difficult for a man to carry in his own padi after the day's work is finished. Except in the monsoonal areas in the north, the soil is usually too wet to allow hand carts to be used in the field; moreover the *batas* (small earth bunds used to control water levels and demarcate boundaries) are usually too steep-sided to be easily crossed by simple man-drawn vehicles and are too narrow to be used as paths. If therefore, the output of grain per man day is increased by the use of machines to a point where the thresher crew and the men on the holding cannot easily carry away the day's produce (which may easily exceed 4,500 lb.) it will be necessary either to rearrange the holdings so that firm tracks for hand carts can be made at appropriate places or to rely on animals or machines to overcome the high rolling resistance of the wet soil in the fields themselves. The former alternative, which involves a considerable waste of potentially productive space, is possible where new areas are being opened up and the size of holding can be increased by complete or partial mechanisation, but is both impossible and undesirable in developed areas where holdings are small and fragmented.

Mechanical threshing may introduce one unique transport problem: experiments have shown that the most economical threshers are often too large and heavy to be used in the field, and the crop must be carried to dry-land. Where the *tuai* (a small knife hold in the palm of the hand to cut the plants just below the heads) is used the bulk of the material to be carried to the thresher is not much greater than that of the grain and no special difficulties arise, but experience has shown that the labour required to carry the loose sheaves reaped with the *sabit* (sickle) may more than offset that saved by the use of the thresher. Two types of tractor-mounted transporter have, however, been developed for use in fields. There are indications too, that a more mobile thresher may be evolved.

Transport Methods.

Bicycles.

The bicycle is likely to remain the most important form of transport in padi areas. It is adaptable, simple and relatively cheap, and it is light enough to be carried over soft patches and narrow bridges. The main disadvantage of the bicycle as a weight carrier is that the centre of gravity of of the load, which is usually carried on a frame over the rear wheel, is very high, and balancing requires great skill. This skill is, however, possessed by most cyclists in padi-growing districts, and suggestions that trade tricycles or bicycle trailers should be used have found little favour.

The Department of Agriculture has developed an experimental bicycle trailer of simple construction which is capable of carrying loads of over 300 lb. in safety. The chassis is built of soft wood and is fitted with a pair of sturdy bicycle wheels: a goose-necked drawbar can be attached to a socket under the bicycle saddle or can be used as a handle for pushing the trailer by hand. The trailer was found to have limited application for carrying heavy loads, such as sacks of padi, but was extremely useful for carrying bulky materials such as fodder.

The cost of carrying padi and other produce on bicycles is difficult to determine and can only be assessed from hire charges. In Selangor, for example, a cyclist can be hired for $2 to carry a sack of padi from Sekinchang to Tanjong Karang: this is roughly equivalent to $4.90 per ton mile.

Hand and Buffalo-drawn Carts.

During the 1953-54 harvesting trials in Kedah a number of two-wheeled hand carts and buffalo carts were seen at work in the fields. The carts, which were fitted with hard wood bodies and shafts or handles as required, had a fairly low rolling resistance because of the large diameter of the wheels. These were between four and five feet in diameter and had narrow rims shod with iron tyres. The hand carts were capable of carrying four sacks (about 540 lb.) or more of padi and the buffalo

carts eight sacks (1,080 lb.). One of these buffalo carts was borrowed to carry grain from a test area, it performed exceptionally well and gave no trouble although soil conditions were such that the combine harvester had to be driven with great care to avoid bogging. Although these wheeled carts are only suitable in the northern, monsoonal areas of the Fedeartion where moderately dry soil conditions can be expected at harvest time, they greatly increase the carrying capacity of man or beast without much capital expenditure.

Buffalo Sledges.

The *anur* or buffalo sledge is commonly used in those areas where animals are used for cultivation and where soil conditions at harvest time are likely to be fairly dry and firm. The care with which the sledges are built and the materials used depend upon the circumstances and the temperament of the owner: well-made wooden types are common but perfectly satisfactory sledges are made by lashing together lengths of bamboo.

The *anur* is not a simple toboggan type of sledge: as can be seen from Plate II the ends of the shafts are extended backwards and bent or carved to form the front pair of runners and the platform, which is extended to form the rear runners, is hinged to the shafts. If a toboggan type sledge were used, a great pull would be required to lift it on to a *batas* and, as the sledge moved forward over the *batas* the front would drop suddenly as soon as the balance point was passed, thus throwing a considerable strain on the harness of the buffalo and probably spilling the load. The articulated arrangement allows the *anur* to cross *batas* more smoothly.

The *anur* can be used on land which is too soft to carry a tractor, but the greatest loads are naturally carried on hard soils. The maximum capacity on dry soil is about three sacks (400 lb.) of padi but it is more usual for two sacks to be carried and for the driver to ride on the sledge. Movement along metalled roads is usually avoided, because of the high rate of wear on the wooden runners and because the noise may frighten the buffalo, but in most areas there is a grass verge along the roadside which can be used as a sledge track if padi is to be carried directly to the mill.

Many *anur* equipped with simple axles and wooden wheels attached to the rear runners were seen during the 1953-54 harvest trials in Kedah. The roughly-turned wooden wheels were about 12 inches in diameter and 3 inches wide and they reduced the draft sufficiently to allow an extra sack of padi to be carried on hard land. Several of the two-and four-wheeled trolleys, without any sledge-runners, were also seen, especially in areas within easy reach of mills. These trolleys had a capacity of between three and six sacks of padi (between 375 and 750 lb.) and were used on metalled roads, their main function being the transport of winnowed padi from kampong to mill rather than the collection of grain from the field.

PLATE I

A buffalo cart with large diameter wheels collecting combined padi.

PLATE II

A typical *anur* of the Kedah type.

PLATE III

The Jib Transporter being used to collect loose sheaves of padi during threshing trials.

PLATE IV

The Box Transporter being tested in Perak.

Neither the *anur* nor the trolley are designed for carrying bulky loads but they could be converted for carrying unthreshed padi to threshers and an *anur* was, in fact, used for this purpose during the tests of the Turner thresher in Kedah, during the 1952-53 season 1(1).

MECHANICAL WHEEL-BARROWS.

A Benford Mechanical Wheel-barrow was tested in Kedah and Perak during the 1953-54 harvest season. This machine, which may be fitted with different types of platform or bucket to suit the type of material being carried, is propelled by a small engine which drives the front traction wheels through a clutch and chains. The clutch is engaged by pressing down the spring-loaded handle, and the wheel-barrow stops if the driver should stumble and relax his pressure. The traction wheels are fitted with 16 x 4 pneumatic tyres and a single castor wheel at the rear of the frame allows the wheel-barrow to be steered.

The Mechanical Wheel-barrow was found to be incapable of climbing the smallest *batas* and its use in the field was limited by the difficulty of steering against the resistance of the padi stubble. It could, however, be used on paths 2½ feet wide and was used for carrying padi and other materials at the Padi Experiment Station at Telok Chengai in Kedah. It could not, however, be turned around on a narrow path, and much time was wasted in following circuitous routes.

Under normal working conditions the cost of fuel came to about 20 cents per hour. On the basis of a 3,000 hour life total operating costs, inclusive of driver's wages, are estimated to be $1.20 per hour, or the equivalent of four men's wages. At no time, however, could this machine be said to perform the work of four men. Nevertheless, it is worth nothing that similar machines are said to have done good work in Sarawak (3).

TRACTORS AND TRAILERS.

The tractor trailer is the normal means of transport on highly mechanized farms in many countries and many tractors on estates in the Federation are used solely or mainly for haulage. On short journeys tractors and trailers are often more economical than lorries; Ferguson tractors, pulling trains of up to six small trailers carrying 10 sacks of padi each, are used in Selangor. No operating figures are available, for there tractor-drawn trains, but it is estimated that the cost per ton mile is only 60 cens for the journey from Sekinchang to Tanjong Karang as compared with $4.90 for hired bicycles over the same route.

A trailer was used for collecting grain and straw bales during the harvesting trials in Kedah, but long detours were necessary to avoid drains and other obstacles and it is unlikely that any type of large trailer will be satisfactory for field use in established padi areas.

TRACTOR-MOUNTED JIB TRANSPORT.

A transporter consisting of a large hessian bag suspended from a locally made tractor-mounted crane jib was developed at Talang, Perak,

during the 1952-53 season (2) for carrying padi from the field to the thresher and an improved version was tested at Simpang Tiga, Perak, during the 1953-54 harvest trials. This transporter consisted of a crane with two jibs mounted at about 30 degrees to each other so that the bag was held open for loading and provisions was made for releasing one end to facilitate unloading. (Plates III & IV). Because the hessian bag was easily torn, an attempt was made to use a string net, but grain losses proved to be high.

In timed tests an everage of 11 loads per hour was carried an average distance of 120 yards with a crew of 3 men. This was equivalent to about 1,100 lb. of threshed padi per hour and was more than sufficient to supply the Turner or Robinson Midget thresher. The results of these tests are compared in Table I with other methods of carrying grain.

The loaded transporter was not very stable because of the high centre of gravity of the load. Care had to be exercised when crossing *batas*, and it was not considered safe to travel on public roads because the load swung from side to side. Sacks of threshed grain could not be carried because the hessian bag tended to split and because swinging was so violent that the jibs bent.

The Tractor-mounted Transport Box.

The use of a standard Ferguson transport box for carrying unthreshed padi was considered in 1953. This attachment for the hydraulic lift of the Ferguson has been used on dry land Experiment Stations, where the wheel-barrow conversion set is often of great value, but it was considered that the box had insufficient bulk-carrying capacity in its tractor-mounted form and that the wheels of the wheelbarrow conversion were too small and too widely spaced to be of use in padi fields. A large box, 8 feet long by 3 feet wide, was therefore constructed of sheet metal with an angle iron frame and mounted on the tractor's hydraulic lift. This box transporter was designed as a dual purpose machine for carrying both unthreshed padi and sacks of grain and was capable of carrying loads of 450 lb.

In field tests at Simpang Tiga, the box was used for both these purposes; in the former case the maximum load was equivalent to about 100 lb. of threshed, clean padi. The box was slightly more difficult to load than the jib since the loose sheaves of padi had to be stacked neatly to allow the maximum load to be carried, and unloading was also slower since the box could not be tipped and the sheaves had to be removed by hand. It was very stable and could be safely driven under all conditions: for example, 15 loads of unthreshed padi were carried several miles along a main road to a demonstration site. The box was used for carrying sacks of padi, fuel, tarpaulins etc. to and from test sites: high speeds could be safely employed and no damage was sustained when crossing *batas*.

In timed tests the average rate of working was 10 loads, or about 1,000 lb. of padi, per hour with an average haul of 100 yards. This was

Table I.

Transport of Unthreshed Padi.

Method	Man hours per acre	Man hours per 1000 gantangs	Approximate cost per acre	Approximate cost per 1000 gantangs	Remarks
Hand, average distance 25 yards	13.0	20.4	$ 3.90	$ 6.13	Average from 7 thresher tests in Kedah and Perak, 1953-1954.
Hand, short distance	13.0	—	$ 3.90	—	Test of Tullos thresher, Malacca, 1952.
Buffalo *anur*, distance 220 yards	37.5	63.5	$11.25 *	$19.05 *	Test of Turner thresher Kedah, 1953.
Tractor-mounted jib, average distance 120 yards	1.5	14.5	$ 6.50	$21.80	Average of three tests, Perak, 1954.
Tractor-mounted box, average distance 100 yards	4.5	14.5	$ 6.50	$21.80	Averag of two tests, Perak, 1954.

* Does not include allowance for cost of buffalo.

slightly less than was carried by the jib but was sufficient to supply a Turner or Robinson Midget Thresher. Since the end of the harvesting trials the box has been used for general work on an Experiment Station and has been particularly useful for carrying mulch.

Buck-rakes and Hay-sweep.

A tractor-mounted hay-sweep for a Ferguson tractor was constructed in 1953 from the parts of an old semi-mounted Farmall implement. The modified machine was intended primarily for sweeping the straw, left by the combine harvester, to a portable baler but it was also intended that it should be used to collect loose sheaves of padi from the stubble and carry them to the thresher. The sweep was very satisfactory for collecting straw but after watching the violence with which the loads shook when the tractor crossed *batas*, it was decided that grain loss due to shattering would be uneconomically high if the sweep were used for collecting padi.

Discussion.

The transport systems in existing padi areas are sufficient to meet present demands and, although something might be done to reduce the drudgery of carrying heavy sacks of grain, there is little need for the introduction of new methods. Where an existing system is upset by the introduction of mechanical harvesting, however, it may break down and consideration must be given to alternative methods of transport. Since the contractors who own the harvesting equipment are almost certain to own tractors, (which are not very satisfactory for driving threshers since the power needed is only about 20 per cent. of that available and does not provide an economic load for the engine), it is probable that tractor-drawn or tractor-mounted vehicles will be acceptable in areas where buffaloes are not common.

The transport of unthreshed padi from field to thresher is a short term problem since it is probable that mobile, high capacity, medium-sized threshers will be developed within a few years. Further development of transporters for bulky loads of unthreshed padi is, however, worth-while. Both types of tractor-mounted transporters tested during the 1953-54 trials performed well. The jib and the box will be further developed.

If the size of holdings is to be increased in new areas with a view to partial or complete mechanization it is probable that there will be insufficient people per unit area for conventional transport methods, but these areas will be laid out specifically for mechanisation and tractors with suitable trailers should be able to work satisfactorily. Large trailers will, however, be difficult to manoeuvre and turn unless very wide paths, which waste potentially productive land, are provided; it is probable that trains of small trailers which can be unhitched and turned around by hand in a very small space will be more useful and more adaptable. The success of the buffalo drawn *anur* suggests that a tractor-drawn sledge, which can be fitted with wheels for road work, is worth developing.

Trials with the Benford Mechanical Wheel-barrow were not generally encouraging, and it is doubtful if a highly specialized machine of this type will ever find a place in mechanized padi farming.

Summary.

1. The scope for improvement in transport methods in padi areas is discussed, and it is suggested that no major changes are necessary in existing areas unless the balance of the present systems is changed by the introduction of more efficient road transport and by mechanical harvesting.

2. The transport of unthreshed padi from the field to firm land, where a medium-sized thresher can be used, is discussed and it is suggested that this is a problem which will eventually be solved by improvements to threshers rather than improvements in transport methods.

3. Various methods of transport and unusual modifications to conventional vehicles are described.

4. Methods of transport tested during the 1953-54 harvesting trials are described and proposals for future developments suggested.

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AN EXPERIMENT IN THE STORAGE OF UNDER-MILLED RICE

BY

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Prelude.

This article was first prepared for publication in November, 1941, just before Malaya was invaded by the Japanese. The records were found again in 1947, and the text has now been slightly revised in respect of some of the interpretations of the results.

Problems of rice storage are still of great importance and a few facts emerged from this experiment which might, with advantage, be placed on record.

Introduction.

The factors relevant to preservation of rice, the usual highly-milled imported rice, by good storage in normal conditions in Malaya have been examined to some extent.

Problems of food supply, however, comprise those of quality as well as quantity, and, in 1938, it was suggested that, owing to the higher nutritive value of lightly-milled rice, the possibilities of handling such rice in commercial quantities should also be explored.

It has generally been understood that lightly-milled rice, still holding a high proportion of the bran layers containing oil, vitamins, minerals and a high percentage of the protein of the rice grain, was subject to more rapid deterioration than highly-milled rice, owing to development of rancidity and greater attraction for insects. No attempt, however, has been made to store such rice in controlled good storage conditions.

It was decided, therefore, to undertake a small experimental storage of under-milled or lightly-milled rice, and on the 5th June, 1939, 10 sacks of under-milled rice from the Government Rice Mill, Bagan Serai, Perak, were put into each of three rooms in the small experimental store attached to the Department of Agriculture in Kuala Lumpur.

The store is constructed of brick, with a galvanized iron roof, raised wooden floors, and concrete apron and drain. It is divided into three sections by brick walls, and these three rooms are fitted as follows:—

Room 1 was very well ventilated, but protected against rats and birds by expanded metal and fine-mesh wire-netting over window, door and wall-top ventilation;

Room 2 was sealed as far as possible with cemented ceiling and rubber-sealed iron door and window;

Room 3 had protected ventilation similar to that of Room 1 but was further screened, against insects, by fine brass-wire gauze on windows and doors, in addition to the expanded metal. This gauze also modified the movement of air in and out of this room, as is indicated by the smaller range of relative humidity in this room as compared with that of Room 1 (Table II).

Care was taken that the sacks did not lean against the brick walls but were stacked in the centres of the rooms.

Relative humidity and temperature records were kept within each store by automatic recording instruments. The thermographs were kindly lent by the Superintendent of the former Meteorological Branch of the Survey Department, and these and the hygrographs used were checked and standardised by the Meteorological Branch before being placed in the store rooms.

Initial and monthly examinations of insect populations were made by an officer of the Entomology Division; chemical analyses and initial and fortnightly tests for moisture content of rice were made by the Chemistry Division; and weight volume ratio tests by the Botany Division, which Division was also responsible for the general supervision of the experiment.

These examinations apply principally to Rooms 1 and 3, as the sealed Room 2 was left unopened for the first three months and thereafter inspected monthly.

In addition to the above recordings, samples of the rice from each room were sent to the Institute for Medical Research where officers of its Chemistry Division very kindly conducted rat feeding tests to estimate nutritive value of the rices at commencement, at three months, and at the end of the experiment.

Temperature and Relative Humidity Records.

Tables I and II are of interest; they show the average weekly air temperatures and relative humidities in each room. The averages are computed by summing the readings at two-hourly points recorded throughout each week. The weekly average maximum and minimum temperatures and relative humidities are shown also in order to indicate the ranges and variation in these respects.

The temperature and relative humidity measurements for the sealed room (No. 2) were recorded over a period of one week in each month. The door was opened at 9 a.m. on fine days for the purpose of extracting charts and recharging the automatic instruments.

Temperature and percentage humidity varied similarly in each room, and in degree of variation varied inversely with the degree of ventilation.

Room 1 shows the greatest range, as might be expected with its more open ventilation, and shows minimum relative humidities well below those of Room 3. On the other hand, at no time does maximum relative humidity in Room 3 approach that of Room 1 and this may be a factor of importance.

Table I.

Temperature within the Rooms.

Week commencing	Room 1 (Very well ventilated)			Room 2 (Sealed)			Room 3 (Screened)		
	General Average	Average Maximum	Average Minimum	General Average	Average Maximum	Average Minimum	General Average	Average Maximum	Average Minimum
	°F	°F	°F	°F	°F	°F	°F	°F	°F
5. 6.39	83.2	90.1	77.8	78.8	79.7	77.9	83.9	88.5	79.7
12. 6.39	83.4	90.6	77.1	78.8	79.7	77.7	83.9	89.2	79.0
19. 6.39	80.8	87.6	75.9	—	—	—	81.6	86.2	77.7
26. 6.39	82.8	90.2	76.8	—	—	—	83.9	89.5	79.4
3. 7.39	82.4	89.8	76.9	—	—	—	83.3	88.5	78.9
10. 7.39	83.3	92.0	76.3	—	—	—	84.2	90.5	78.5
17. 7.39	82.6	91.4	75.6	—	—	—	83.4	89.5	78.0
24. 7.39	83.3	91.8	76.1	—	—	—	84.2	90.1	78.6
31. 7.39	81.8	89.3	75.5	—	—	—	83.6	89.1	76.8
7. 8.39	82.8	88.2	78.3	—	—	—	82.8	90.9	77.0
14. 8.39	81.7	90.7	76.4	—	—	—	82.0	87.8	77.0
21. 8.39	83.3	91.4	76.2	—	—	—	83.4	88.5	78.3
28. 8.39	83.5	91.3	77.5	—	—	—	83.6	88.5	79.0
4. 9.39	81.9	90.1	76.3	82.9	83.9	82.0	82.0	87.5	77.9
11. 9.39	80.5	87.2	75.4	83.4	83.7	82.7	80.7	85.0	76.7
18. 9.39	82.2	89.5	76.7	—	—	—	82.2	86.8	77.9
25. 9.39	80.7	87.5	76.2	—	—	—	80.7	84.9	77.8
2.10.39	79.8	87.2	75.3	83.7	84.2	82.7	80.2	84.3	76.8
9.10.39	82.4	89.3	76.7	84.5	85.3	84.0	82.4	86.7	78.5
16.10.39	82.3	88.8	77.5	—	—	—	82.3	86.2	77.4
23.10.39	81.3	88.2	77.0	—	—	—	81.5	85.5	78.5
20.10.39	82.5	90.1	77.2	84.9	85.5	84.3	82.3	87.1	79.0
6.11.39	83.5	91.2	77.5	85.6	86.2	84.4	83.7	89.3	75.1
13.11.39	82.5	90.2	77.5	—	—	—	82.2	87.2	78.4
20.11.39	81.8	90.4	76.1	—	—	—	82.1	87.8	77.8
27.11.39	82.9	89.5	77.2	—	—	—	82.7	87.3	78.8
4.12.39	82.4	89.6	77.3	85.4	86.2	84.5	82.4	87.0	78.3
11.12.39	82.6	90.2	76.8	85.5	86.4	84.6	82.4	86.6	78.2
18.12.39	83.0	91.0	76.2	—	—	—	83.3	88.1	78.3
25.12.39	82.6	89.8	74.8	—	—	—	82.3	86.7	76.8
General Mean	82.3	—	—	—	—	—	82.6	—	—

Table II.

Percentage Relative Humidity of the Air in the Rooms.

Week commencing	Room 1 (Very well ventilated)			Room 2 (Sealed)			Room 3 (Screened)		
	General Average	Average Maximum	Average Minimum	General Average	Average Maximum	Average Minimum	General Average	Average Maximum	Average Minimum
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
5. 6.39	82.0	94.6	58.5	72.3	74.0	69.0	75.6	82.0	66.0
12. 6.39	83.6	95.0	60.0	73.4	74.6	70.9	77.7	83.0	68.3
19. 6.39	85.4	95.7	62.1	—	—	—	79.8	85.0	69.6
26. 6.39	82.3	95.3	57.0	—	—	—	77.1	83.3	65.6
3. 7.39	81.6	94.3	59.3	—	—	—	77.6	84.0	67.0
10. 7.39	77.2	94.6	50.4	—	—	—	72.3	80.6	59.1
17. 7.39	79.4	94.3	53.1	—	—	—	76.0	82.4	62.0
24. 7.39	79.7	94.8	54.8	—	—	—	76.4	80.0	62.3
31. 7.39	78.6	94.7	55.3	—	—	—	74.5	82.4	62.6
7. 8.39	81.0	95.1	55.7	—	—	—	74.4	81.1	62.7
14. 8.39	78.0	93.1	51.6	—	—	—	73.4	80.6	62.1
21. 8.39	79.6	95.7	56.1	—	—	—	74.3	82.0	63.1
28. 8.39	84.3	96.8	57.8	—	—	—	75.8	82.3	64.3
4. 9.39	79.4	93.7	56.1	83.9	85.5	81.3	77.7	82.7	67.3
11. 9.39	86.6	96.6	66.0	82.8	84.0	80.3	79.9	83.0	74.7
18. 9.39	80.9	95.6	57.6	—	—	—	76.8	81.7	68.0
25. 9.39	86.5	96.7	64.6	—	—	—	81.6	86.3	72.6
2.10.39	87.7	97.8	66.9	83.1	84.6	81.4	84.7	85.7	73.7
9.10.39	82.8	95.8	61.8	81.4	83.3	80.0	77.4	83.4	70.0
16.10.39	83.3	95.4	62.7	—	—	—	79.0	84.0	69.8
23.10.39	86.7	97.1	66.0	—	—	—	81.5	85.4	73.7
30.10.39	84.5	97.1	62.3	85.2	87.0	83.4	80.2	85.1	70.8
6.11.39	81.3	95.3	58.6	85.0	87.0	83.0	76.9	83.0	67.1
13.11.39	82.8	96.0	56.7	—	—	—	76.7	82.0	65.1
20.11.39	81.6	95.3	57.7	—	—	—	77.2	83.4	65.7
27.11.39	81.5	95.1	63.7	—	—	—	76.6	82.4	68.3
4.12.39	82.6	95.6	58.7	85.5	87.4	83.6	77.6	83.0	67.4
11.12.39	76.9	93.0	57.6	85.0	87.0	83.0	75.7	82.1	65.4
18.12.39	75.6	92.1	55.1	—	—	—	71.3	78.6	60.8
25.12.39	72.4	89.0	52.7	—	—	—	67.7	76.0	57.6
General Mean	81.4	—	—	—	—	—	76.7	—	—

In mean air temperature there is little difference between the very well ventilated Room 1, and the well ventilated but screened Room 3, but in mean relative humidity, Room 1 is consistently higher, a difference which is naturally reflected in air moisture content (Graph I).

The simultaneous rise of temperature and relative humidity in the sealed Room 2 is difficult to explain. Both temperature and relative humidity rose steadily throughout the experiment, showing a narrow range of variation, and the usual inverse relationship between these was not exhibited. This means that the air moisture content was also rising (Graph I).

There are three ways in which the moisture content of the air could have been increased:—

(a) by diffusion of moisture from moist grain to dry air; but moisture content of the grain rose from 8.8 per cent., which is very low, to 12.8 per cent. during the course of the experiment;

(b) by the production of metabolic water due to the breeding and multiplication of insects. Water content of grain can be raised several per cent. by *Calandra* and other insects, but only in very small patches as very high lethal temperatures would quickly be reached;

(c) by ingress of moisture from the outside.

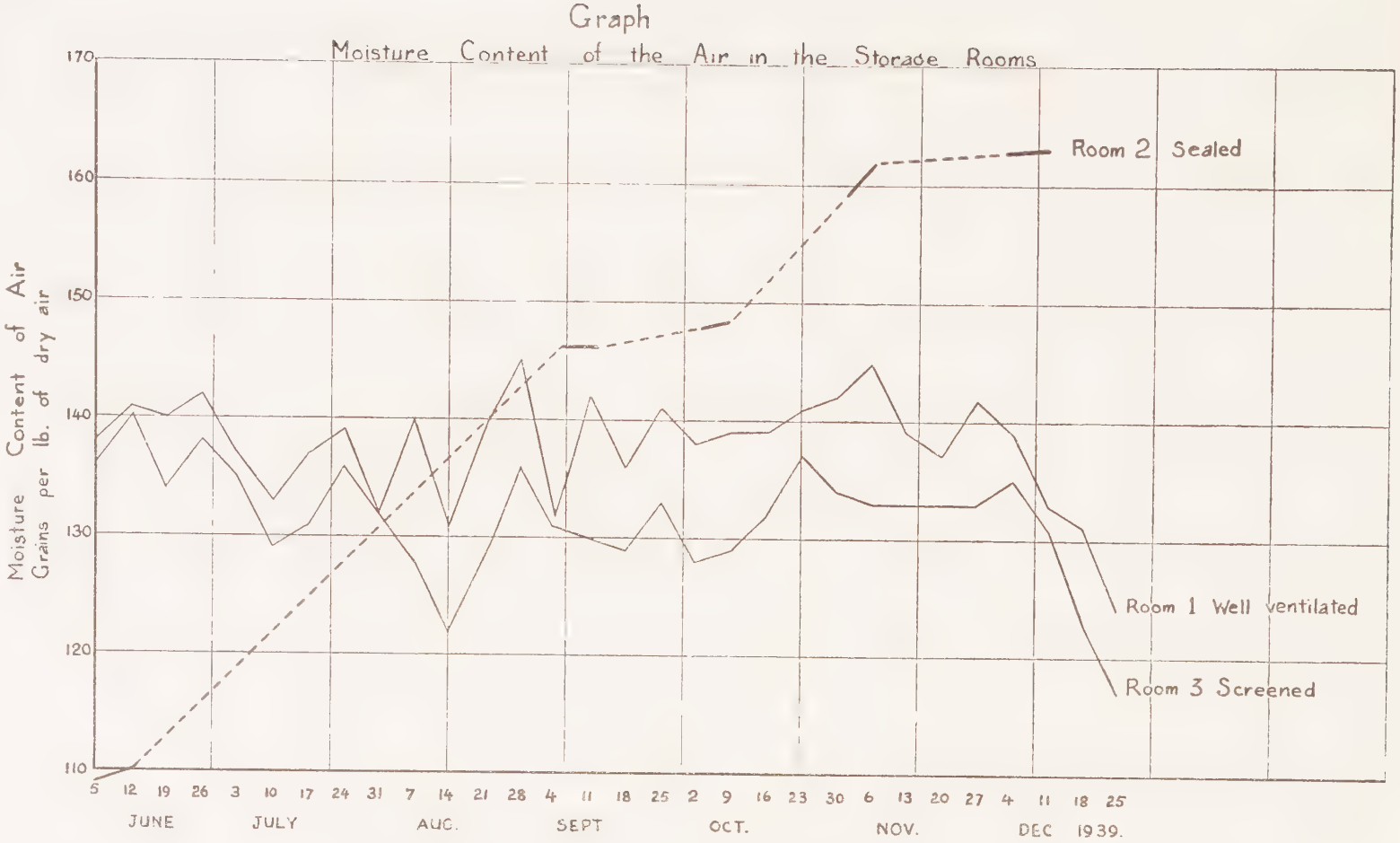
Rises in temperature and in relative humidity in the sealed Room 2 may, therefore, have been caused, in part, by the development of insects in the rice, but this cause could not account for the very considerable rise in air moisture content which can only be attributed to ingress of water from the exterior in spite of the precautions taken to seal the room. This must have been due to the rise of moisture vapour through the boarded floor which, although raised a few inches from the ground, was presumably influenced by the soil below.

It must be emphasised that this form of sealed room clearly does not provide conditions which are comparable with truly air-tight containers or stores in which welded metal containers have been used, or in which walls and floors have been suitably water-vapour proofed.

It may be that in a tropical climate such as that pertaining to Kuala Lumpur, the normal effect of sealing a building in this way, over a period of months, is to cause a slow rise to a temperature higher than is normally reached in an ordinary building. This, combined with the rise in humidity, was sufficient to produce intolerably bad conditions of storage towards the end of the period, although they were preferable to those in the other rooms at the commencement of the experiment.

Rice in Rooms 1 and 3 kept well for five months, but afterwards, rice in Room 1 (very well ventilated) continued, gradually, to deteriorate, while that in Room 3 (screened) remained very little changed.

Rice in the sealed Room 2 deteriorated most rapidly. Some of the sacks in this room ultimately weakened and burst when they were being moved, a condition which is compatible with the very humid conditions


Graph
Moisture Content of the Air in the Storage Rooms
Moisture Content of Air
Grains per lb. of dry air
170
160
150
140
130
120
110
Room 2 Sealed
Room 1 Well ventilated
Room 3 Screened
5 12 19 26 3 10 17 24 31 7 14 21 28 4 11 18 25 2 9 16 23 30 6 13 20 27 4 11 18 25
JUNE JULY AUG. SEPT OCT. NOV. DEC 1939.

which finally prevailed. It will also be noted that conditions in Room 2 were also very favourable for the breeding and hatching of *Corcyra* moths, of which a few larvae were present at the beginning of the experiment. These moths appeared in very large numbers later on, as is described in the next section, "Entomological Records". The occasional door-opening probably had a momentary effect on the humidity of air but could have had nothing to do with the original emergence of *Corcyra* moths on or before the 4th September, 1939.

Entomological Records.

The three major insect pests of stored rice are the rice weevil, *Calandra oryzae* and the two "cluster" moths, *Corcyra cephalonica* Stn. and *Ephestia cautella* Walk. The flour beetle, *Tribolium* is of secondary consequence, although it may be able to eat off the testa which remains in under-milled rice.

At the beginning of the experiment there were very few insects of any kind present, but a *Tribolium*, a *Rhizopertha* and a few larvae of *Corcyra* or *Ephestia* moths were found.

After one month there was a distinct increase, particularly of *Tribolium* and moths, while a few rice weevils (*Calandra oryzae*) appeared in Room 3 (screened).

After three months, the rice in all three rooms was lumpy due to *Corcyra* and *Ephestia* moths, the larvae of which make small clusters of rice grains in which to pupate. The rice was most lumpy in Room 1 (well ventilated), and least in Room 3 (screened), although in opposite ratio to the numbers of pupae and larvae which were found. Presumably moths in Room 1 had already emerged and had flown away. Moths were very numerous in Room 2 (sealed), as they could not get away, but were absent in Room 3 (screened), from which they could also not have escaped.

No explanation of this can be given though it is possible that a longer life history cycle for moths in Room 3 might have been the reason.

Calandra weevils had appeared in all rooms, and were fairly numerous in Room 3.

Tribolium was very numerous in Rooms 1 and 3 but in smaller numbers in Room 2 (sealed).

After four months, there was a considerable reduction in numbers of insects, except lepidopterous pupae, which were numerous in Rooms 2 and 3.

There appeared to be a distinct reduction in numbers of *Calandra* in Room 3, and slight incerases in Rooms 1 and 2.

At the end of the fifth month, adult moths were again present in Room 2 in large numbers. This alternation of adults, larvae and pupae is explained by the comparatively short adult life of the moths and that the inspection after four months' storage must have occurred between hatches.

There was little change in numbers of other insects present.

At the end of six months, moths and their larvae were most

numerous in Room 2, and *Calandra* was present throughout, though not in large numbers, and least in Room 3 (screened).

The ant *Solenopsis geminata* Jerd. invaded Room 1 in the second month and was observed carrying dead larvae of *Ephestia* and *Corcyra*. It may also have attacked living larvae of these moths, and *Tribolium*. The ant was constantly present thereafter in Room 1.

At the examination after three months storage, the anthocorid bug, *Piezostethus* sp. had made its appearance in all three rooms, though mostly in Room 2, and by the end of six months, had greatly increased in numbers in Room 2. This bug has been observed to prey on Psocids and probably attacks young larvae of other grain insects.

It will be noted that although, by some chance, *Calandra oryzae* was first present in Room 3, and most numerous there at three months, the subsequent rate of multiplication was lowest in that room. Moisture contents of the bulk of the rice were much the same in all three rooms, but it is in the superficial layer of grain that most insect breeding takes place, but it may be presumed that the moisture contents of the superficial layers of the rice in Room 3 were lower than for similar rice in the other rooms. Unfortunately, as has already been observed, these moisture contents were not measured and recorded.

Table III.

Date of Sampling	Room 1 (very well ventilated)		Room 2 (Sealed)		Room 3 (Screened)	
	Weight / Volume Ratio (lb. per bushel)	Moisture per cent.	Weight / Volume Ratio (lb. per bushel)	Moisture per cent.	Weight / Volume Ratio (lb. per bushel)	Moisture per cent.
7. 6.39	63.0	9.2	63.0	8.8	63.0	8.8
21. 6.39	62.0	10.6	—	—	61.5	11.0
17. 7.39	61.5	11.2	—	—	61.0	10.4
14. 8.39	61.0	11.0	—	—	60.5	10.8
4. 9.39	61.5	11.6	62.0	10.0	61.0	11.6
2.10.39	61.5	12.0	61.5	11.0	61.0	12.0
30.10.39	61.5	12.4	61.0	12.2	61.0	12.8
4.12.39	61.5	12.6	61.5	12.4	61.0	12.6
2. 1.40	61.0	12.4	61.0	12.8	61.0	12.4

The figures in Table III show that there is a steady decrease in weight/volume ratio and an increase in moisture content of rice very similar in all three rooms, and the figures give no indication of the differences in methods of storage or their respective merits.

Sampling of the rice was made with a long, tubular, grain sampler and the samples which were the bases of these moisture determinations were, therefore, taken mostly from the centre of the sacks.

Greater differences in moisture content of the superficial layer of grain might have been recorded if samples of grain from the top of the bags had also been tested. This is an important omission as it is in the

superficial grain that most insect breeding takes place, and deterioration of grain is most evident.

Chemical Analyses.

As one of the main purposes of this storage experiment was the investigation of the practicability of the use of under-milled rice as a commercial grade, with preservation of relatively high nutritive value apart from starch, the chemical analyses for oil, protein and minerals in Table IV is an important commentary on the experiment.

General average figures for oil, protein, mineral and carbohydrate components of local hulled or brown rice and of highly polished rice are also given to provide standards for comparison with those of lightly-milled rice, before and during the experiment.

It may be seen that there is really relatively little dietetic gain by use of lightly-milled rice, for most of the oil and protein in the rice bran layers had already been lost by one light milling.

There is a further drop in protein content after three months storage, which shows recovery after seven months storage, but due solely to loss of starch as a result of insect damage of the starchy kernel and to decomposition of the fat. This protein recovery is, therefore, not real but only relative

The most significant figures in Table IV are those which show the decreases in oil or fat contents due to decomposition and insect attack.

Vitamin value estimations do not appear in the chemical analyses, but it is perhaps of significance that the final relative value for petroleum ether extract correspond closely with determinations of relative vitamin B1 values by rat-feeding tests.

Estimation of Vitamin B1 Values.

A sample of the original rice was sent to the Institute for Medical Research in order that its vitamin B1 value might be determined by feeding tests with rats. At the end of periods of three and seven months, samples of the rice from each of the three (experiment storage) rooms were also sent for further feeding tests in order to determine what effect the conditions of storage had on the vitamin B1 content.

Control tests were also made with the following diets:—

Control A—Washed rice. This diet is free from vitamin B1.

Control B—A full natural diet of carrots, green beans, French beans, padi and soup bones.

Control C—The rice undergoing test, with the daily addition of five International Units of vitamin B1, for each rat, in the form of a solution of aneurin.

These feeding tests were carried out with young white rats in groups of ten for the original rice, and in groups of eight for the subsequent series. Each group contained equal numbers of males and females, the usual precautions being taken to distribute offspring from the same litters in different groups.

Table IV.

Results of Chemical Analyses of Samples of Under-milled Rice during Storage Experiments.

(Calculated on moisture-free basis).

Constituents	General Averages		Under-milled Rice before Storage (5.6.1939)	After 3 Months Storage			After 7 Months Storage		
	Local Hulled Rice	Highly Milled Rice		Room 1	Room 2	Room 3	Room 1	Room 2	Room 3
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Oil (Petroleum ether extract	2.60	0.45	1.36	1.17	1.28	1.30	0.80	0.60	0.89
Protein (N x 6.25)	9.20	6.75	7.57	7.22	7.40	7.24	7.57	7.63	7.28
Ash (chiefly P_2O_5)	1.45	0.90	1.00	0.93	0.92	0.96	0.90	0.95	0.95
Carbohydrates—Fibre	0.80	0.32	0.40	0.36	0.37	0.37	0.39	0.40	0.41
Carbohydrates—Soluble	85.95	91.58	89.67	90.32	90.03	90.13	90.34	90.42	90.47

The tests were begun on each occasion with young rats weighing between 40 and 50 grammes. The tests were continued for 20 weeks, the rats being weighed each week. Any rat in the tests that showed signs of paralysis was thereafter given 10 International Units of Vitamin B1 each week.

Table V gives the number of rats in each group which showed signs of paralysis.

Table VI shows the average total increase of weight per rat during the period of 20 weeks. The figures in this table do not include those rats which showed signs of paralysis.

The tables indicate that after seven months there is practically no loss of vitamin B1 in the rice stored in Room 3 and relatively very little loss in the rice in Room 1; both these rooms are well ventilated. In the rice in Room 2 (Sealed), there appears to be considerable loss of vitamin B1, probably about half of the original content, which loss is evident even after three months of such storage.

Table V.

Number of Rats suffering from Paralysis.

Diets	5.6.1939		5.9.1939		2.1.1940	
	Males	Females	Males	Females	Males	Females
Control diet A. (highly-milled rice)	5	3	4	4	4	4
Control diet B.	0	0	0	0	0	0
Control diet C.	0	0	0	0	0	0
Room 1 rice	0	1	0	0	1	1
Room 2 rice	0	1	3	1	3	2
Room 3 rice	0	1	1	0	0	1

Table VI.

Results of Feeding Tests with Rats.

Average Increase in Weight of Rats during 20 Weeks.

Diets	5.6.1939		5.9.1939		2.1.1940	
	Males	Females	Males	Females	Males	Females
	grm.	grm.	grm.	grm.	grm.	grm.
Control diet A. (highly-milled rice)	—	—	—	—	—	—
Control diet B.	183	107	179	94	184	102
Control diet C.	146	103	113	92	171	119
Room 1 rice	104	88	74	84	96	62
Room 2 rice	104	88	44	44	56	44
Room 3 rice	104	88	75	64	100	85

The samples of rice in Rooms 1 and 2 were, at the end of the seven months storage, little different in appearance, yet Tables V and VI show that there was a distinct difference in nutritional values which does not appear in chemical analyses, except as a greater oil deficiency of the rice in Room 2.

The rice in Room 3 was distinctly the best in appearance, and it would appear from the above records that it is slightly the less reduced in nutritive value, also, than the rice in Rooms 1 and 2.

Comments.

The planned experiment was terminated on the 2nd January, 1940, after seven months storage of the under-milled rice. The experiment had indicated again that, for normal short-period storage of rice, good ventilation is advisable, in addition to cleanliness of store and protection against entry of rats and birds; but for periods of more than five months, some modification of this condition would appear to be necessary.

It was not possible to prove here, however, whether the modification with wire gauze was of more value as protection against insects or as a restriction of the entry of too much moist air. It is believed that the latter hypothesis is the correct one, for although the difference in air temperature was only slightly in favour of Room 3 (screened), it was in this room that relative humidity was maintained at the lowest maxima and lowest average. It may be significant, too, that the air moisture content of Room 3, as shown in the accompanying graph of calculated weekly averages, remained slightly but consistently below that of Room 1.

The moisture contents of the rice in these two rooms were not different, and it seems evident that air moisture has very little effect beyond the first superficial inch or so of the rice with which it is in contact, and that uptake and loss of moisture of the rice beyond this superficial layer is a very slow process.

Continuation of the Experiment.

The writer went on leave to New Zealand in January, 1940, the rice being still in the store rooms. At the end of February, as Room 3 was required for tests with padi, the rice in Room 1 was put into Room 2 with the other damaged rice already there, and the relatively good conditioned rice in Room 3 was put into Room 1.

Although the original Room 3 rice, now in Room 1, was therefore next examined by the writer on his return from leave, it was still in excellent condition after sixteen months storage. The grain was still exposed to entry of and attack by insects and to freer ventilation, when sound, although sacks were dusty on the outside. Later, after twenty months storage, on examination by officers of the Entomology Division, it was found to be remarkably free from living insects, except *Piezostethus* on the outsides of the sacks.

Moreover, when 10 pairs of *Calandra* weevils were introduced to

a sample of this rice in the laboratory of the Entomology Division they increased only to 14 during a period of two months, thus demonstrating that the rice had probably become an unfavourable medium for the breeding of this insect past. The moisture content of the rice was then 14 per cent., so that it cannot be due to the lowness of moisture content, but perhaps to hardening of the outer layers of the rice grains after 20 months storage in favourable conditions.

Palatability and cooking tests were made and it was found that the rice required more water and 30 minutes instead of 15 to 20 minutes for proper cooking, but was then quite as palatable as similar fresh rice; any difference of palatability between it and fresh undermilled rice was rather in favour of the stored rice.

To check variations in some of the feeding test results, a short feeding-value test was carried out with sixteen months stored rice, which agreed with earlier results.

Observations and Conclutions.

This experiment was carried out in 1939-40, when, owing to the higher nutritive value of under-milled rice, it was being considered as a practical commercial proposition.

It has been indicated that the nutritional advantage with under-milled rice lies largely in the higher oil content and, presumably, the fat-soluble vitamins contained therein. The nutritional advantage of higher fat content compared with highly-milled rice is, however, largely lost owing to ready decomposition of the fat. The advantage in higher protein value is small.

In view, therefore, of the greater attraction of under-milled rice for insect pests and the risk of rancidity, any slight advantage in nutritive value is not considered compensatory for the greater risk of deterioration in under-milled rice compared with highly-milled rice in normal storage conditions.

It has been shown, however, that under-milled rice, if in clean, dry condition, can be preserved for five months free from serious infestation by weevils and other insect pests, and in good edible condition in a clean store, protected against entry of vermin, but well ventilated.

It has also been shown that similar rice was kept in good condition for much longer than five months in the store in which the above conditions were modified by insect-proofing with fine wire gauze. Continued observations showed in fact that under-milled local rice, which had been kept for nine months in a store with good ventilation, modified by wire gauze protection over door and window, arrived at a condition in which, with continued good, well-ventilated storage, not necessarily further protected by wire gauze, it remained in very satisfactory condition for a total period of over twenty months.

The beneficial effect of the wire gauze may be in the modification of ventilation and the reduction of maximum relative humidity rather than in the exclusion of insect pests.

This is an observation of interest with regard to storage of grain in a moist tropical climate, and indicates that while, for normal "godown" storage of rice, good ventilation of the store is necessary to control rise of temperature, it is advisable to avoid too free an entry of moist atmosphere.

It has also been shown, by rise of air moisture content in the sealed room, that, where ventilation is too greatly restricted, water-vapour proofing of the floor (and perhaps the walls) of the store is necessary.

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STUDIES ON SEED-BORNE MICROFLORA AND THE EFFECT OF SEED TREATMENT OF RICE.

BY

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Preliminary studies on the seed-borne microflora of rice indicated a relatively high percentage of rice seed contaminated with various fungi, some of which are usually associated with padi diseases. A few isolation tests yielded the following fungi:—*Helminthosporium oryzae*, *Nigrospora* spp., *Curvularia* spp., *Cercospora oryzae*, *Piricularia oryzae*, *Fusarium* spp., *Pestalotia oryae*, *Coniothyrium* spp., and a few others which were not identified. A small percentage of seed gave rise to bacterial colonies but no attempt was made to identify any of these.

After the preliminary isolations 10 samples of rice seed were obtained from the Division of Botany. All these samples originated at Telok Chengai Padi Experiment Station, Kedah, and at the time of testing were approximately eight months old. Two lots of 100 seeds each were taken from each of the 10 varieties, one lot surface being sterilized for two minutes in 0.1 per cent mercuric chloride solution while the other was left unsterilized. The seed was plated on moistened filter paper in Petri plates which were left on a desk at the prevailing temperatures of the laboratory. Readings were taken one week after plating when most of the seed had already germinated. See Table I, series (a).

Since rice seed used in Malaya is ordinarily only about four months old, further samples of more recently harvested seed were obtained from the Botany Division, and tested in July, 1954. The seed in the latter test varied in age from three to six months . See Table I, series (b).

It is evident from these tests that, although all the seed looked clean and healthy, the percentage of contamination by various fungi ranged from 15 to 100 with an average of 55.3 per cent. Slightly less than one third of this contamination consisted of surface-borne inoculum as shown by the effect of surface sterilization. The remainder was apparently inoculum which had penetrated the hulms, or even the seed, and was not affected by surface sterilization.

As could be expected, the abundance of seed-borne microflora varies from year to year and from place to place depending on the weather conditions during maturation and harvesting of the crop. The composition of the microflora also varied between different seed lots. Some lots carried mostly moulds and other innocuous fungi, while others were affected mainly by pathogenic organisms.

Table I.

Percentage of rice seed contaminated by various micro-organisms.

Variety	Origin	Unsterilized	Surface Sterilized
SERIES (a), 8 months old:			
Anak Didek 39	Kedah	28	25
Haji Haroun	,,	25	18
Mayang Ebos 80	,,	23	0
Mayang Tekai 41	,,	25	10
Radin Kling	,,	43	42
Radin China 4	,,	15	8
Radin Siak 34	,,	83	40
Radin Goi	,,	60	10
Serendah Sungei Dua	,,	18	15
Subang Intan 117	,,	15	0
SERIES (b), 3-6 months old:			
Acheh Puteh	Selangor	96	49
G. Tembeling Puteh	Pahang	95	92
Haji Haroun	Kedah	69	56
Kontor	P. Wellesley	60	49
Lentek	Johore	84	76
Machang	Perak	43	22
Mayang Ebos 80	Kedah	44	29
Mayang SaBatil 8	Penang	44	23
Mayang SaGumpal	Kelantan	29	12
Milek Kuning 3	Pahang	93	66
Nachin 11	Malacca	25	24
Nalong Telor	Kelantan	89	75
Pe Mi Fun	P. Wellesley	89	50
Radin Che Ali	Perak	100	96
Radin Kling	Kedah	61	31
Reyong 6	Malacca	91	77
Seraup Kechil 36	Perak	49	32
Serendah Kuning	N. Sembilan	46	30
Seri Raja	Perak	19	11
Subang Intan 117	Kedah	57	37
Taichung 65	P. Wellesley	58	49
Trengganu	Johore	92	77

The prevalence of various fungi on rice seed indicated that seed treatment with an effective disinfectant might be beneficial and, therefore, several laboratory tests and one field trial were made. In each case two equal lots of seed were counted, one of which was then treated with an organic mercury seed disinfectant (Agrosan GN) at the rate of 1.5 oz. per bushel, and the other left untreated. These were planted in pots except for the one field test which was planted at Pulau Gadong Experiment Station, Malacca. After the seedlings had developed to the second

or third leaf stage, they were pulled out of the soil, counted and separated into a strong and healthy, and a diseased group. A summary of these tests is presented in Table II, and the growth of seedlings from treated and non-treated seed is shown in the photograph (Fig. 1).

Table II.

The effect of seed treatment on germination and disease control in rice.

Variety	Untreated		Treated	
	Per cent germination.	Per cent seedlings diseased.	Per cent germination.	Per cent seedlings diseased.
SERIES (a), 8 months old:				
Nachin (unselected)	8	75.0	29	3.3
Radin Kling	87	24.1	95	0.5
Radin Goi	93	3.2	92	0
Radin Siak 34	65	37.5	85	0.5
Siam 29	59	10.0	62	0.7
SERIES (b), 3-6 months old:				
Acheh Puteh	12	33.3	32	0
G. Tembeling Puteh	92	10.9	98	0
Kontor	95	15.8	100	1.0
Lentek	96	34.4	98	2.0
Machang	96	4.1	100	2.0
Mayang Ebos 80	87	26.4	97	4.1
Mayang SaBatil 8	94	8.5	95	2.1
Mayang SaGumpal	96	3.1	97	2.1
Milek Kuning 3	96	8.3	96	2.0
Nachin 1	86	17.4	96	5.2
Nalong Telor	95	14.7	94	4.2
Pe Mi Fun	90	18.9	91	5.5
Radin Che Ali	82	39.0	98	7.1
Reyong 6	59	22.0	80	6.2
Seraup Kechil 36	93	14.0	97	1.0
Serendah Kuning	96	21.9	94	0
Seri Raja	91	15.3	99	2.0
Subang Intan 117	91	19.9	98	2.0
Taichung 65	89	20.2	96	4.1
Trengganu	91	23.0	95	1.0

It is evident, from the results of these seed treatment tests, that an increase in the percentage of germination may be obtained with treated seed, particularly in older seed with reduced viability, as well as good control of seed-borne diseases.

Accurate percentage of germination and the percentage of diseased seedlings were not determined in the field test. The plots were examined six weeks atfer planting and at that time the plots seeded with treated

seed were approximately of double the density of stand, and the plants were several inches taller, than the controls. The practical value of seed treatment is thus fairly clearly indicated.

The most important pathogenic padi diseases observed in Malaya in the 1953-54 crop year were leaf spots on nursery plants. Fungi inciting these leaf spots, mainly *Helminthosporium*, *Nigrospora*, and *Cercospora* spp. may, to some extent, be carried from season to season on alternate grass hosts but it is very doubtful if this source of inoculum is very important. Seed-borne inoculum, under the common Malayan practice of seeding on the surface of the ground in close-sown nurseries, starts to increase from the day of seeding, through germination and the development of the young plants. Thorough seed treatment with an effective seed disinfectant will very considerably reduce this source of inoculum and thus enable a development of more sturdy and even growth of plants.

At the prevailing price of organic mercury seed disinfectant, the cost of dressing per bushel of seed would be less than ten cents. One bushel of padi or seed rice weighs approximtely 46 lbs., so that cost of seed dressing would amount to less than three cents per acre of transplanted seedlings.

The economic benefit of seed treatment cannot well be evaluated without comparative crop trials, but although Malaya is relatively free from serious diseases of rice, a reduction in the incidence of *Helminthosporium*, and other leaf-spotting diseases which can be so controlled, would undoubtedly result in improvement in yields of grain in some regions and seasons, to an amount far in excess of the cost of seed treatment.

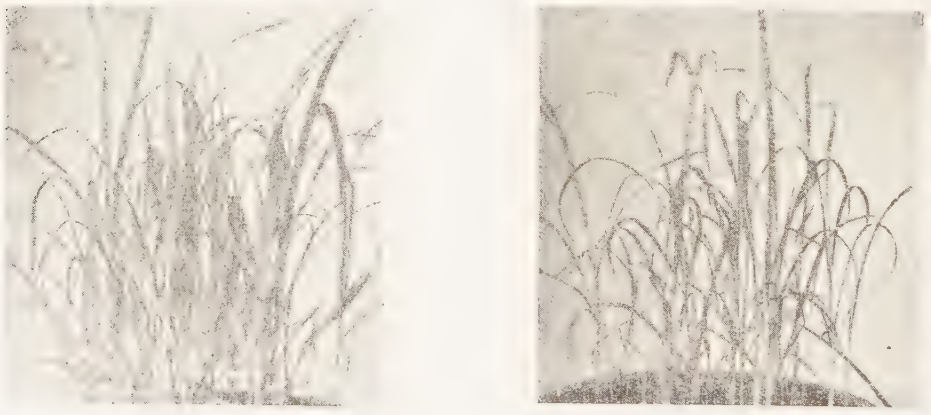

Fig. 1. Seedling growth from (a) treated seed and (b) check.

NOTES ON CURRENT INVESTIGATIONS, RESEARCH

APRIL TO JUNE, 1954

Compiled by the Chief Research Officer.

Padi.

Work during the quarter has been concerned mainly with compiling and statistical analysis of results of last season's variety and selection trials. Sowing, and in some cases transplanting, of the new season's variety trials and selection plots is well under way at east Pahang, Kedah and Province Wellesley Stations. Harvesting at the Selangor Station has been completed but results of trials are not yet to hand. Programmes of experimental work for the coming season have been drawn up and distributed to State/Settlement Agricultural Officers.

Variety Selection.

Records of all varieties under selection (except for Acheh Puteh in Selangor) have been received and selection of material for planting in the coming season completed.

Final stocks of 40 to 60 selections of Nachin, Siam, Serendah Kuning, Seraup Kechil, Mayang Sabatil and Radin Ebos are being maintained pending completion of final selection field trials. Progress of selection still in the year row phase is as follows:—

		No. of Lines.	
		1952-4	1954-5
Anak Naga (Kota Bharu)	....	267	100
Acheh Puteh (K. Selangor)	....	138	*ca*100
Seri Raja (Simpang Tiga)	....	1000	585
Seri Raja (Talang)	....	1000	*ca*800
Mayang Sagumpal (Jelawat)	....	1000	811
Machang (Titi Serong)	....	F.S.	1000
Serendah Puteh (N. Sembilan)		F.S.	1000
Radin Kling (Gajah Mati)	....	—	F.S.

The progress to date of varietal selection work has recently been reported on elsewhere in detail. Examination of results of previous work suggested methods of accelerating selection and improving technical efficiency; their implementation is, however, handicapped by lack of land and shortage of funds.

Hybridisation.

Of 45 doubtful local hybrids grown in F_2 last season, 24 have been discarded as accidental selfs. The remaining 21 are included with other hybrid material being carried forward.

Laboratory Investigations.

Further imbition tests with milled rice have been carried out. Variation between and even within varieties is striking. Among Nachin strains, increase in volume by water absorption on cooking varies from 69 per cent. to 250 per cent.

Germination tests on padi stored under varying conditions has shown that after two years, there is little loss of viability of seed stored in an air-conditioned room at about 78°F.; whereas after nine months, padi stored at normal room temperature and humidity showed only 46 per cent. germination, which fell to zero after 13 months.

Examination of meiotic material of seven families of Cuttack *indica* x *japonica* hybrids has shown no chromosomal abnormalities. In each family, 100 dividing cells ranging from M.I to A.II in microsporogenesis and also pollen tetrads and grains were examined. Chromosome number, behaviour and pollen size variability were normal. It is assumed that sterility in this cross is genic in origin.

Nutrient Requirements.

The study of nutrient uptake in 6 plots of Siam, 29, unmanured, at Tanjong Karang in the 1954 season has been completed.

The results are complicated in that the areas selected for analysis were badly flooded on two occasions during the trial.

The general picture with all the elements studied shows a rapid uptake of nutrient during the first month after transplanting, followed by a steady decline towards harvest.

Potassium showed extremely rapid uptake after transplanting and a sharp drop just before harvest. Phosphate showed less marked changes, rising one month after planting and then steadily declining. Calcium decreased slightly between the second and third month. Magnesium showed great variation between plants, but there was no significant change over any period.

Iron and maganese were generally fairly constant, the variations found were probably due to flood contamination.

The results on this one series are of sufficient interest to merit further work which is being planned for 1954/55 in conjunction with the Statistician.

Cacao.

Selection and Breeding.

Work during the quarter has been of a routine nature and mainly concerned with the accumulation of production and pod analysis records of selection stocks. Some 6,600 pods have been recorded during the quarter.

Harvest of pods from experimental fields was 7,955 pods in April, reaching a peak in May with 9,067 pods and falling to 2,084 pods in June.

Upper Amazon Strains. 45 pods have been harvested during the

quarter and their characteristics have been recorded. The number of beans per pod varied from 30 to 50, averaging 40.7; the mean weight of wet cacao being 113.6 gms. One tree has produced 9 pods averaging 40 beans and 117 gms. Cacao and another 5 pods with 48 beans and 140 gms. cacao. About a third of the trees have not yet fruited.

Compatibility Testing. General compatibility testing has been suspended for the last three months owing to the increasing number of anomalous results. The cause is being investigated by experimentation on pollination techniques and testing will shortly be resumed.

Fermentation. A study of the chemistry of Malaya cacao, with its possible bearing on fermentation problems, has been started. Steps have also been taken to make it possible to carry out micro-fermentation tests.

Disease Contro y.

Two cacao plants at the Federal Experiment Station, Serdang, in the early stages of red root rot infection, were treated by baring the top layer of main roots and then drenching them with an organic mercury fungicide No. 580. Three weeks later these plants were examined and both showed new flushes of growth. Unfortunately one of these, which received more careful treatment, was later broken by storm and its stump dug out and destroyed. The other plant is still growing.

Another test on red root rot control involved fumigation with KCN of a plot of soil at the Federal Experiment Station, Serdang, on which stumps of *Ganoderma*-killed coffee and shade trees were left standing, and another of plot around cacao plants killed by the same disease. The effectiveness of this fumigation will be determined by planting a susceptible host on these plots without the removal of dead stumps.

Pest Control.

In a field trial with Dieldrin emulsion (1.8 per cent. actual) against the Cossid borer *Zeuzera coffeae* Nietn., counts made at fortnightly intervals over a period of 14 weeks showed a total of 35 bore-holes in 11 out of 93 treated trees compared with 64 bore-holes in 13 out of 94 control trees.

Previous insecticidal soil tests against *Apogonia* beetles showed that BHC at 0.03 per cent. actual was the most toxic insecticide used under the conditions of the experiment. It was decided to see how a concentration of BHC decreased to 0.02 per cent. compared with rates of Aldrin and Dieldrin increased to one part in 50 and one part in 100 of water. Tests at periods of from three weeks to three months after spraying are in progress with two different soils.

Oil Palm.

Breeding Programme.

Tenera material. Several lots of *pisifera* pollen and seed have been received from West Africa and are being used for production of dumpy palms with *tenera* type fruit.

Several dumpy bunches previously pollinated with local and imported *pisifera* pollen have been reaped and the seed sown. Field trials with this material are planned and the nursery for the first of these trials has been planted.

Other lots of *tenera* seed from West Africa have also been received and sown.

Disease Control.

A leaf blight of young oil palm plants was investigated and the main organism found on the blighted leaves was *Colletotrichum* sp. A spraying test with four different fungicides for the control of this blight was arranged at an estate. The results are not yet available but preliminary report indicates that an organic mercury fungicide appears to be more effective than copper formulations.

Pest Control.

The bagworm *Cremastopsyche pendula* Joannis has been reported from an estate in South Perak where it continues to be a pest over 2,000 acres. Two visits were paid and observations made with relation to measures for its control. Most of the larvae occurred on the upper leaves and pupated on the middle ones, only empty cases being found on the lower leaves. It was found that fogging with a 'TIFA' using water prior to dusting with lead arsenate, gave a 78 per cent. kill of bagworms, 60 per cent. using a Diesel oil fog and only 36 per cent. when dusting onto leaves wet with dew. Four species of Hymenopterous parasites and a predacious beetle (*Callimerus arcufer*, Chap.) were recorded from the cases.

Coconut.

Breeding.

Attention is being given to cultivation of the coconut area at Port Swettenham and 35 nuts have been harvested from selected trees.

Pollen storage tests have shown that coconut pollen can be stored at room temperature and 40 to 50 per cent. relative humidity for 30 to 40 days with a loss of viability of 50 per cent. or less.

Pest Control.

Information is being accumulated from various estate managers and agents on the cost of control measures against *Oryctes rhinoceros* L. with a view to assessing the value of possible measures for its biological control by the Zanzibar wasp *Scolia ruficornis* F.

Tea.

Rooting Trials.

A rooting trial of tea cuttings at Cameron Highlands has been completed and the best results were obtained by rooting in media with

a high sawdust content. It is proposed to adopt a standard rooting medium consisting of 2/3 sawdust and 1/3 loam in raised beds, good drainage appeared to be more important than the medium used. No improvement in rooting resulted from the use of hormones. It is proposed to commence rooting cuttings from selected bushes in the near future.

Disease Control.

A spraying test for the control of blister blight and other leaf diseases on tea with four new fungcides was established at the Federal Experiment Station, Cameron Highlands.

Pineapple.

Selection.

A selection plot is being established at Alor Bukit Experiment Station. A first batch of 600 clones has been transferred there from Jalan Kebun.

Disease Control and Soil Mineral Deficiencies.

Inoculations of pineapple plants with fungi isolated from rotten roots of the same host and incorporating rotten roots under the potted plants both failed to give rise to root rot. This may indicate that the so-called root rot of pineapple occurs only on plants weakened by some other factors but the causal organism has not yet been isolated.

Examination of the various fertilisers trials on pineapple plantations in Perak revealed the great importance of the proper balance between the three major elements, NPK. There is also indication that one or more microelements other than copper may be deficient.

Pest Control.

Examination of Sarawak pineapples, of which six had been inoculated with the mealy-bug *Dysmicoccus brevipes* Ckill. and six isolated as controls, showed that this variety is susceptible to mealy-bug wilt. This results in the fruit being only half the weight, stunted, sour and delayed some 2½ months compared with normal uninoculated plants.

Pasture and Fodder.

Green Fodder.

Work has continued on monthly sampling of Trial F.E.S.S. 126 (Manurial on pasture with Shade). An analysis of protein and grass yields shows significant improvement over the first year with both nitrogen and potash dressings. A marked rise in nitrogen content also takes place place after ammonium sulphate treatment. However the crude protein figure never rises above 3.0 to 3.2 per cent., the normal range being 2.8 to 3.0 per cent. which is not enough for "balanced" after (3.5 per cent.).

Vegetables and Food Crops.

Groundnut.

The selection lines at Serdang have been harvested. Yields were poor due to rat damage and inclement weather; 214 selections have been retained for replanting.

Spices.

Cloves.

Encouraging results have been obtained against eggs and hatching larvae of both species of Cerambycid clove borer with Dieldrin in concentrations down to 0.18 per cent. actual, and it appears that it is not necessary to aim at killing the adult beetles before they oviposit, as was at first believed, and that it may be possible to achieve equally good results in the field at this lower concentration. This will reduce the cost of materials for treatment to one-seventh of its present amount.

Examination of clove plantations in Penang and the subsequent study of the material brought in, including the isolates established from the diseased specimens, revealed beyond doubt the presence of both the wound pathogen, *Cryptosporella eugeniae* and the sudden death disease, *Valsa eugeniae*. In one specimen *Valsa* infection occurred either through a stem wound or at the point of attachment of a branch rather than through the roots. This conclusion is in accord with the latest finding in Zanzibar.

Fibres.

Ramie.

During the quarter two crops have been reaped from both the clonal trial and the time of cutting trial and one from the spacing trial. This completes a second series of nine crops from the clonal trial which will be discontinued in analysis of the results prove satisfactory .

Jute.

Spraying tests on Jute for the control of stem canker are in progress.

Soils Investigations.

Soil Survey, Singapore.

As stated in the previous report, the field work on 16,000 acres of potential food production area in Singapore had been completed. The laboratory analyses have now been finished and a final report issued.

Soil Survey, Trengganu.

The Soil Surveyor spent a fortnight in Trengganu reconnoitring areas which might be suitable for more detailed soil surveys with parti-

cular reference to their suitability for development for cacao. The general impression gained from this reconnaissance is that the soils of the coastal belt are poor, as are also those developed on the Carboniferous shales on the hills fringing the coastal belt. The alluvial soils in the basin of the Sungei Trengganu and its tributaries (the Sungei Brang etc.) look promising as do those on the low granite hills which occur between the main range and the coastal deposits. An area west of the Kuala Trengganu—Ajil—Jerangau Road, as covered by topo sheet 2 L/13 and 14, has been selected for more detailed survey.

Temerloh-Maran Road Area.

With the construction of the new road from Temerloh to Maran, a considerable area of soils derived from andesite, has been brought to notice. The extent of this area is as yet unknown but the indications are that there is considerable lava flow in the area. A preliminary survey was organised and this showed that the soil covered more ground than was at first thought.

Soil Survey, Trans-Perak Area.

The soil survey of the Trans-Perak area continues. Six teams, employed by the Consultant Engineers have been at work and during the quarter under review, 771 samples have been received. The samples which have been received to date indicate very considerable amounts of good clay soils in the area.

Soil Survey, Briah Swamp.

The Survey Department, in conjunction with the Drainage and Irrigation Department, has started a survey of the Briah Swamp, an area of 25,000 acres near Parit Buntar, Perak. An initial survey was made before the detailed soil survey was started and this showed that, though a considerable part of the area had peat on the surface, this was very shallow being of the order of 12 to 18 inches; often there was sand underneath.

Soil Survey, South Bank of Bernam River.

The Drainage and Irrigation Department, Selangor is undertaking a survey along the south bank of the Bernam River and, apart from taking levels, the aim has been to find out how far south of the river land covered with less than 4 feet of peat extends. Indications are that deep peat, i.e. more than 4 feet deep, reaches quite close to the river.

Pulau Tawau.

320 soil samples from this area have been examined for their suitability for padi.

Water Movement in Soils.

With the decision to establish a soils/water relationship station at Sungei Burong, Selangor, it was obvious that some measurement on the rate of water movement on the rate of water movement through the sub-soil would be desirable in order to get information on which to base the construction of bunds. Bore holes sunk in the area and then pumped clear of water showed that there was a very rapid movement of water in the sub-soil. This indicated that bunds built on the surface would not be suitable for maintaining water tables at different levels in adjacent plots. The possibility of puddling a trench filled with soil and then building the bund on top of this is being investigated and the sub-soil water movement between adjacent plots separated in this manner is also being examined.

"Penyakit Merah".

The experiment to test the effect of major element deficiencies and the presence of soluble aluminium on the growth of padi plants in nutrient solutions has not been so far very successful. It is now suspected that zinc from the wire-mesh plant holds is being dissolved in sufficient quantities to make the solutions toxic to padi plants. There is, however, a definite indication of deficiencies which are in accord with previous similar experiments. Phosphorus and iron deficiency show reddening of the leaf margins followed by necrosis. The presence of aluminium in the complete solution shows similar necrosis. Nitrogen deficient plants show lack of tillering and are lighter green while potassium deficient plants do not so far show any symptoms.

A test has been established on two soil samples from areas of most severe *penyakit merah* during the last season, to determine the effect of dolomitic lime.

The experiment to determine the effect of NPK, Ca. and minor minerals on the development of *penyakit merah* on 16 soil samples is in preparation. A similar field test was planned and arranged for in Kelantan, Perak, Kedah, Penang and Malacca.

Laboratory Technique Investigations.

Plant Analyses.

Plant analysis is at the moment confined to analyses of padi plants grown in sand culture with a number of different solutions.

Soil Analyses.

Analyses of "gelam" soils for base exchange capacity, exchangeable manganese and silica-sesquioxide ratios have continued. The rate of extraction of potash from soils using acetic acid has also been examined.

Canning Research.

Canning Research Station.

The staff has been engaged on routine canning of pineapples from Alor Bukit trials, and former field trials. The examination of all cans packed up to the end of 1953 has been completed. The examination of current trial samples is proceeding in rotation six months after canning. All Canning Research Station samples have been examined for troublesome "paraffin" off-flavour which has occured in commercial packs, but no authentic instances have been found.

The Station co-operated in the laying down of two large canning trials with the Lee Pineapple Company to test the effect of trontrolled staling of fruit on the incidence of the "paraffin" off-flavour. The examination of the sample of fruit of the first trial has started.

Papaya canning has proceeded where possible. Mixed strains of market fruit with golden flesh have been packed for exhibition purposes.

A test batch of Malayan ginger was packed in heavy syrup. It was found that information on this pack was lacking. The samples were fair, and were good enough for further trials.

Termites.

Termites.

The residual effects of Dieldrin in soil at strengths of from 1/500 to 1/1250 of Dieldrex 15 have been found to persist for five months—the test insect was *Macrotermes gilvus* Hag. There are indications that the residual effect varies wih the soil type. The test was under cover.

Resistance to attack from the same species of termite has persisted in samples of a proprietary material, tanalised timber and plastic-covered cables placed in termite-infested soil in the field.

NOTES ON CURRENT INVESTIGATIONS, AGRONOMY APRIL TO JUNE, 1954.

Compiled by the Senior Agronomist.

Padi.

Harvest was completed in all localities during the quarter and almost all experimental results have been received. Good progress has been made with statistical analysis preparatory to writing up results of the last three years' manurial experiments.

Simple manurial trials on small-holders' land have shown widespread response in yield to NPK fertilizers in scattered small padi areas in many parts of Perak, Pahang and Negri Sembilan and to NP fertilizers in Kedah, Perlis and Province Wellesley. However, responses continue to be disappointing or absent in the larger irrigation areas of Perak.

A 27-plot factorial trial sited on a small-holder's padi field in west Pahang gave useful results so it is clearly practicable to use complex designs on some cultivators' land.

It is interesting to note that experimental yields of up to 1,540 lb. per acre of padi have been obtained from old deep peat land at Chenderong Balai, Perak. Phosphate appears to be the major element which is chiefly required but there is circumstantial evidence that certain trace elements may also be beneficial. This evidence is to be followed up by new experiments. Repeated drainage and cultivation of this soil have increased the mineral content and the surface now consists of a muck soil.

Exeprimental crops from a newly-opened area of peat soil at Padang Kemunting, Trengganu, have been virtual failures because of water shortage and insect damage.

At Paya Besar Padi Test Station, in East Pahang, experimental crops of up to 474 gantangs per acre have been recorded or 540 gantangs per acre where cages have given protection from birds. The soil is a poor one and requires fertilizers and above-average drainage to obtain these results. In the past it was suggested that this soil was unsuited to padi cultivation. At the same locality, manured crops of dry padi have also been unusually good with maxima of 253 gantangs per acre or 450 gantangs per acre with protection from birds. Off-season crop trials with legumes and maize have shown conclusively that heavy applications of fertilizer are required. Growth of all crops was virtually prevented in the absence of manuring.

Cacao.

West African Amelonado cacao planted at 15 x 15 ft. under clonal durians spaced 30 x 30 ft. is now in bearing, two years from planting, at Selama Agricultural Station, Perak. At Bukit Gantang, in the same State, a similar mixed orchard is also growing very well indeed and the combination promises to be of great value.

In a shade and spacing trial at Gajah Mati, Kedah, it is reported that the absence of tertiary shade in certain plots has led to sun scorch when the cacao grew above the secondary banana shade.

At the Federal Experiment Station, Jerangau, Trengganu, a nursery technique trial has emphasized the importance of regular watering of basket seedling nurseries.

It has now been established that leaf-scorch of seedlings at Jerangau can be prevented by incorporation of ground limestone and double superphosphate in the market compost. The double superphosphate cannot be replaced by equivalent single superphosphate so that trouble may be caused by sulphate or soluble aluminium toxicity.

A shade density and watering frequency experiment with seedling cacao has emphasized the value of the higher shade densities but the effect of four different watering frequencies is not clearly defined. Partial protection from rain using "Windowlite" is also of value it is impossible to differentiate between the effects of this material in reducing light intensity and keeping off rain.

Two establishment trials on Malacca estates have been discontinued, one because of inadequate shade, the other because of poor growth. In each case the variety was Trinitario.

Oil Palm.

Old palms, 25 years old, growing on a coastal clay soil on a Perak estate have shown a response in yield to applications of nitrogen as sulphate of ammonia. This estate has agreed to lay down a comprehensive manurial trial on 6-year-old palms.

Fibres.

Good quality fibre is being produced on two estates in Selangor from experimental crops of Manila hemp grown on coastal alluvium. In one case the hemp is interplanted with young oil palms but it is clearly important not to have too high a stand of stems in order to avoid forcing up the young palms.

A portable Hagotan stripping machine has been made for the State Agricultural Officer, Pahang, and this is to be on display at two Agricultural shows. In test-running it has performed well.

Bolo harvesting knives are being fabricated locally in order to evolve an efficient design.

Tea.

In a pruning trial of highland tea at the Federal Experiment Station, Cameron Highlands, all the lightly pruned plots came into plucking one month earlier than the medium and heavy pruned plots.

Pineapples.

A co-operative type-of-potash experiment on a Johore estate gave its first crop early in the year. This trial, which is duplicated at the

Federal Experiment Station, Jalan Kebun, Selangor, was designed to test the effect on yield of fruit and fruit size both of equivalent and equal-value applications of muriate and sulphate of potash. Actual applications were as follows:—

A 100 lb. per acre K_2O as muriate (Chloride)—60 per cent K_2O.
B 100 lb. per acre K_2O as sulphate— 48 per cent K_2O.
C 80 lb. per acre K_2O as sulphate— 48 per cent K_2O.

When the trial was laid down the fertilizers applied in treatments A and C cost the same. The experiment also tested two methods of applications:-

X Fertilizers applied to the soil in a ring around the plants.
Y Fertilizers mixed with 5 times their bulk of peat and applied to the outer leaf axils.

Yields of fruit in lb. per acre are summarized in the following table:—

	A	B	C	Mean	
X	14,324	13,734	16,069	14,709	±40.828
Y	14,324	13,804	16,182	14,770	
Mean	14,324	13,769	16,125	14,739	
		±676.42			

Differences were non-significant by the "F" test so the apparent superiority of C over B must be treated with reserve until it is checked by the first experimental yield at Jalan Kebun. Hence there is no reason to suppose that the more expensive sulphate of potash offers any advantage over the muriate. In this trial the mean fruit weight was 3.935 lb. and treatment differences were negligible.

An important replanting experiment which was harvested in Johore in April gave a mean yield of 10,470 lb. of fruit per acre but the incidence of fruit rot was very high. The various manurial and cultural treatments under test did not appreciably affect the disease incidence.

Pineapples are being successfully catch-cropped with young oil palms on a Perak estate and the practice appears to benefit the palms. On the same estate some interesting experiments are in progress on the application of fertilizers in spray form. It appears that relatively concentrated spray solutions can be used without damage to the pineapples.

Coffee.

Growth of Liberian coffee continues to be good in two manurial experiments on deep peat soil at Jalan Kebun, Selangor. Some plants are in flower but many are showing leaf-chlorosis, especially those plots lacking potash. Mechanical intercultivation has perhaps been too frequent as the rate of peat oxidation appears to be high and this point will require to be watched carefully.

Vegetables and Foodcrops.

A soft-shelled variety of Job's Tears, *Coix lacrymajobi*, which originated in Brazil, was imported recently from Trinidad via the Commonwealth Mycological Institute, Kew. An observation crop was sown

in Kuala Lumpur on 8.5.54 and is now growing vigorously although germination was very slow.

In a *Lobak* variety trial in Kuala Lumpur three local strains have out-yielded the imported Sutton's Chinese White variety, whereas in an earlier experiment the opposite result was obtained. Similarly in a series of Pak Choy experiments the performance of two Japanese starins, Kyoto Nos. 2 and 3, has sometimes been disappointing but it is now clear that the former is the superior one.

Green Manures.

Some interesting observations are in progress in Kedah on a number of green manures of potential value for padi cultivation. *Sesbania aculeata* is by far the most promising of all species under trial as it was found to germinate rapidly and was able to withstand both drought and flood. It attains a height of 3½ ft. in two months, it seeds early and abundant root-nodules are formed. *S. speciosa* also germinates rapidly and can withstand flooding but not severe drought. This species also seeds quite well when vigorous. *S. Roxburghii*, which has a prostrate habit, is somewhat less promising although resistant to flooding and drought. However, there has been no formation of seed or root-nodules.

Other species under test are *Aeschynomene americana, Indigofera teysmanni* and *Crotalaria juncea*. The first is fair under water-logged conditions but is not drought-resistant; the second grows very rapidly but requires good conditions of growth; the third germinates rapidly but cannot withstand drought.

Pastures.

In a factorial manurial experiment at Serdang on shaded pasture botanical observations carried out by the Research Branch have shown that nitrogen depresses *Mimosa pudica*, phosphate encourages sedges and, to a lesser extent, lalang, while potash also depresses *M. pudica*. The chief yield responses on this particular soil are to nitrogen and potash.

Hay grass, *Dichanthium caricosum*, is growing very vigorously indeed in observation plots in north Kedah and Kuala Lumpur. It would appear to be a promising species as it is known to produce a little seed in Selangor and it may well seed more heavily further north.

NOTES ON EXTENSION WORK

MARCH TO MAY, 1954.

Compiled by the Chief Field Officer.

Padi.

The padi harvest is now completed except for some late areas on the Selangor coast. Yields were below average on the east coast but in all other areas yields have been satisfactory.

The results of the season's varietal and manurial extension trials have been received, they are now being analysed but the following general observations can be made.

In Malacca 80 seed farms located throughout the principal padi areas demonstrated the value of planting selected strains of padi. In coastal areas, Reyong 6 averaged 381 gantangs per acre as compared with 326 gantangs per acre from neighbouring plots planted with unselected seed. In the inland areas, Serendah Kuning 3 yielded 350 gantangs per acre on the seed farms as compared with 288 gantangs from unselected padi varieties.

Results from fertiliser demonstration plots located on cultivators' lands indicate that the standard NPK. fertiliser used at Pulau Gadong Experiment Station will increase yields on the coastal sawahs; results from the inland areas have been variable.

In Kedah and Perlis extension manurial trials consisting of 149 blocks were laid down. Each block measured 66 x 66 ft. Within each block there were three manured plots and one unmanured plot. The average yield of the manured plots was 514 gantangs per acre and the average of the unmanured plots 444 gantangs per acre. Manured plots thus gave an increase of 70 gantangs per acre over the unmanured plots.

In Negri Sembilan there were 200 Padi Extension trials consisting of 150 varietal and 50 manurial trials. With few exceptions they were all harvested successfully. In the varietal trials the three varieties selected by the Botanical Division have given larger yields than the unselected Serendah Kuning, and unselected Serendah Kuning seed produced by the Department has also given greater yields than kampong seed. The lowest percentage increase in yield recorded from the use of the selected strains was 4 per cent. and the highest 30.6 per cent.

Responses in the manurial trials have been positive. In all cases it was demonstrated that a mixture containing N.P.K. is better than a mixture of NK or PK and that these in turn were much better than no manure. Over the whole State of Negri Sembilan the increase in yield from manured as against unmanured was 140 gantangs per acre, the mean yield from manured plots being 512 gantangs per acre.

The State Agricultural Officer, Kedah, reports that bat guano distribution has increased considerably during the past quarter. Sampling

of roadside heaps of bat guano has been carried out, and the results of the analysis received from the Chemical Division have shown that in most localities the manurial value is surprisingly high.

Rubber.

535,890 clonal seedlings were sold and distributed in the west coast areas during the quarter, 18,117 yards of budwood were also sold. The short rainy season is not widely favoured for planting and many planters believe that little advantage is gained since seedlings planted out later in the year, during the main rains, will usually catch up with the other seedlings planted in the short rains preceding the dry season.

A major task during recent months has been the laying of plans for a greatly increased production of clonal seedlings. Budwood exists in sufficient quantity to supply all demands, but smallholders much prefer the easier established and maintained clonal seedlings. Indeed there is evidence that where clonal seedlings are not sufficient smallholders prefer to wait rather than tackle the technically superior method of budgrafting. The task is one of considerable magnitude. With a replanting target of 50,000 acres per year it is estimated that nearly 400 acres of clonal seedling nurseries should if possible be established, requiring a seed supply of 24,000,000 seeds.

Reports from the districts indicate a growing tendency to replant with alternative crops. Officers of the Department are called upon to inspect the plots and advise on their suitability for the crop proposed. The State Agricultural Officer, Johore, reports that in the Pontian district 55 acres out of 75 acres of felled rubber were planted with pineapples. In Johore South, 21 and 17 acres respectively have been planted with padi and fruit. In the whole State, applications to replant with other crops cover 1,259 acres.

In South Kedah, it has been agreed to convert 1,100 acres of old rubber land to wet padi.

Fruit.

There has been an increase in the rate of production of budded fruit trees. During the past two quarters sales totalled 16,043 as compared with 26,700 for the whole of 1953.

The demand, in budded trees, is predominantly for rambutans which constitute more than seventy per cent of the total sales, the balance is mainly durians followed by mangoes and pulasans to a lesser extent. Seedlings of papaya, mangosteen, langsat, carambola, duku are also raised in the Department's nurseries for sale. Citrus species are usually raised from cuttings and marcots.

Demand still exceeds supplies. Unfortunately rambutans do not lend themselves to methods of mass production on the lines familiar in citrus growing countries. They require a high standard of maintenance in the nurseries, more than average skill in budgrafting and they must

be lifted carefully and basketted without root disturbance if heavy losses are to be avoided.

Pineapples.

The State Agricultural Officer, Johore, reports that the use of a copper spray is becoming widespread among smallholders. A Departmental pump has been issued on loan in Pontian and it has been reported that there has been a general improvement in the condition of the plants.

In Selangor, a survey of pineapple smallholdings has been completed and as a result of the findings of this survey it has been decided to lay down a series of demonstrations on improved practices and manuring on smallholders land. Money to cover the cost has been voted by the Pineapple Joint Industrial Council.

Coconuts.

A general improvement in the condition of coconuts has been reported from Johore Central. More attention is being paid to the maintenance of holdings affected by the Parit Batak high level drain scheme, and many new bunds have been built in the Batu Pahat coastal areas.

Livestock.

Goats.

Substantial distribution of pure bred and high grade goats have been made from the Federal Experiment Station, Serdang, to the States and Settlements. Some have gone to private breeders but the majority have been sent to the Department's Extension Stations for the purpose of building up high grade flocks for subsequent use in district extension work.

The following is a summary of the distribution:—

British Alpine	No.	Saanan	No.	Anglo-Nubian	No.
Pure Male	4	Cross Bred	2	Pure Male	2
Pure Female	5	Pure Male	27	Pure Female	2
Cross Bred	10			Cross Bred	7

Poultry.

1,021 head of poultry, 700 chicks and 1,941 hatching eggs were sold during the quarter.

Despite the low fertility and hatchability rates experienced by most breeders of pure bred poultry there is undoubtedly a growing interest in poultry keeping throughout the Federation. In most States and Settlements smallholders are seeking and obtaining loans from the Rural & Industrial Development Authority for this purpose, and new and larger farms are to be found in and near all the towns.

Pigs.

There has been a substantial fall in the live weight price of pork from $100 to $75—$80 per picul. This is a welcome tendency as prices have been very high since the industry was severely disorganised by the regrouping and resettlement schemes. The fall in prices is a sign that the industry is getting back to normal.

During the quarter the Department's farms sold 163 head of pure Midddle White stock, but in nearly all Chinese areas there are private beeders and stud centres from which we receive no records.

Agricultural Education.

In Perak South the first agricultural course for Ketuas was held at the Degong Agricultural Station from 17—29th April. Fifteen ketuas attended. At the Gajah Mati Agricultural Station a one-month Budding Course was attended by 25 men.

Reports have been received from all States and Settlements of lectures and demonstrations given by members of the staff to such widely differing groups as Women's Institutes, Civic Courses in New Villages, Field Days and special courses for school children.

Departmental Notes

Obituary.

It is with much regret that the accidental death is recorded of Che' Kassim bin Yusuf, Junior Agricultural Assistant at Layang Layang, Parit on 15th July, 1954.

Che' Kassim joined the Department in October, 1946 and had previously served at Degong Agricultural Station and Selinsing Padi Station.

He was one of the Department's most promising young officers; he leaves a widow and three small children.

Resignation.

Mr. E. A. Rosenquist, Botanist, resigned to take up a research appointment with a local planting group interested in oil palms. Mr. Rosenquist assumed duty on 11th January, 1949, and was stationed at the Federal Experiment Station, Serdang. He has been in immediate charge of Departmental oil palm and cacao breeding programmes, and, in 1952, he visited, under Departmental auspices, the West African Cacao Research Institute, at Tafo, Gold Coast, and the West African Oil Palm Research Institute, at Benin, Nigeria.

He left the Federal Experiment Station, Serdang on 8th May, 1954 to take up his new employment, his resignation being effective from 26th July.

We are sorry to lose a keen and efficient officer and wish him well in his new environment.

New Appointments.

Dr. J. Dore has been appointed Botanist (Plant Physiologist) with effect from 21st July, 1954.

Mr. A. V. Haddon has been appointed Botanist (Plant Breeder) with effect from 21st July, 1954.

Mr. G. F. Darnell has been appointed an Agronomist with effect from

Mr. J. R. Dunsmore has been appointed an Agronomist with effect from 23rd August, 1954.

Mr. M. J. Smith has been appointed an Agronomist with effect from 23rd August, 1954.

Mr. M. J. Strickland has been appointed an Agronomist with effect from 23rd August, 1954.

Appointments.

Mr. R. Henderson, M.C. has been appointed to act as State Agricultural Officer, Kelantan, as from 1st August, 1954.

Mr. R. J. A. W. Lever, Entomologist, has been appointed to act as Senior Entomologist with effect from 1st August, 1954.

Leave.

The following officers have proceeded on leave:—
Mr. J. Cook, Senior Agricultural Officer on 1st August, 1954.
Mr. F. B. Brown, Botanist on 4th August, 1954.
Mr. J. A. Cox, Development Officer on 6th August, 1954.
The following officer has returned from leave:—
Mr. A. Johnston, Plant Pathologist on 28th August, 1954.

Mr. H. T. Pagden—Retirement.

Mr. H. T. Pagden, M.A., F.R.E.S., Senior Entomologist has taken leave on 1st August, 1954, prior to retirement.

Mr. Pagden joined the Department as Assistant Entomologist in January, 1928, and was early engaged on the study of the incidence of infestation, and the possible control, of stem-borers of padi plants, spending much of his time at Parit Buntar in Krian.

During the rubber slump of 1932, and the consequent retrenchment policy, Mr. Pagden was seconded, while on leave in U.K., to the British Solomon Islands Protectorate, primarily to study immature nutfall of coconuts.

He returned to Malaya in July, 1935, as Rice Research Entomologist, and acted as Senior Entomologist from May to August, 1940.

He was an active member of the Kuala Lumpur Flying Club, and served with the Volunteer Air Force during the recent war in Malaya, Sumatra and Java, and then with No. 222 Group R.A.F. in Ceylon, being attached to the Navigation Section and was appointed as Navigator 2 at Group Headquarters in May, 1943. In December, 1942, he was attached to the organisation subsequently known as Force 136, and in October, 1943 he was flown to England for special duties, returning to the eastern war theatre in May, 1944.

He returned after the war as Staff Officer II, Chinese Affairs, Singapore, and later as Acting Secretary for Chinese Affairs, Singapore. He returned to normal duties with the Department of Agriculture as Senior Entomologist in May, 1946, and was appointed to act as Director of Museums, Malayan Union, in addition to his normal duties, on 1st January, 1947, relinquishing this post when he proceeded on leave in May, 1948.

Since 1948, Mr. Pagden has twice been released (over many months) for special "Emergency" duties with the Malayan Police.

His particular professional interests of later years have been the possibilities of biological control of *Proceras* sp. and other padi stem-

borers, the control of pests of stored grain and other plant products, a study of termite species and their control, borers of the clove tree and their control, and the life history and control of the Bombay locust in Malaya .

Mr. Pagden will be greatly missed, both as a very able and efficient entomologist, and as a distinctive Departmental personality. It is likely, however, that some of of his former colleagues in Kuala Lumpur may occasionally see him, as he intends to settle in Malaya, probably in Penang, and continue his studies of the Longicorn borers of the clove tree and of Malayan Hymenoptera, on which he is a recognised authority.

He takes with him our very good wishes for a happy retirement.

Statistical

MARKET PRICES

April to June, 1954.

Rubber.—The Singapore market closed for 3 days at Easter. The price of R.S.S., No. 1, F.O.B. in bales which was 57⅜ cents on 1st April was 61⅛ cents on 20th after the holidays and 63⅝ cents on the 30th.

In May the price of R.S.S., No. 1, F.O.B. in bales fluctuated from 60 cents to 64⅜ cents, averaging 62.45 cents.

During the month of june the price varied from 62½ cents on the 1st to 67⅝ cents on the 30th.

(These figures are taken from Monthly Statistical Bulletins of the Federation of Malaya).

The average prices paid for smallholders' rubber at three centres in the Federation of Malaya during the period January to March, 1954, are given in Table I.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, April to June, 1954.

(Dollars per picul of 133 1/3 lbs.)

Grades.	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	April	May	June	April	May	June	April	May	June
Smoked Sheet	67.86	70.48	73.72	67.85	69.81	73.64	67.05	69.69	73.41
Unsmoked Sheet	57.06	58.83	60.76	51.72	54.37	57.33	59.57	60.45	65.00
Scrap	31.52	33.66	35.96	33.50	36.65	40.36	22.76	21.53	27.20

This Table has been compiled from statistics supplied by the Registrar of Statistics, Federation of Malaya.

Tea.—There were no public sales of Malayan tea in Colombo during the period April to June, 1954. The average prices paid for Ceylon teas at the sale held in Colombo on the 28th June, 1954, as quoted in the *Weekly Report of the Colombo Brokers' Association* were High Grown Teas 2.32, Medium Grown Teas 2.20, Low Grown Teas 2.25 rupees per lb.

In a return published by the Registrar of Statistics, Federation of Malaya, production of made tea in the Federation, as declared by estates,

during the second quarter of 1954 was given as 52,398 lbs. green teas and 1,122,296 lbs. black teas.

During the quarter the retail price of Malayan tea (Boh) in Kuala Lumpur remained unchanged at $2.50 per lb.

Derris.—The price of this commodity dropped from $105 to $100 on 5th April and remained at that price until the end of June.

Rice.—During the quarter the weekly ration of Government imported rice remained unchanged i.e. 5 katis for males, 4 katis for females and 3½ kaits for children. The various retail prices also remained unchanged except for the Lower Grade, the price of which was 22 cents per kati.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil*	Pepper, F.A.Q. Muntok white	Pepper, Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1954								
5th April -	29.25	53.00	270.00	280.00	53.00	13.25	16.50	14.50
12th April -	32.50	53.50	250.00	260.00	52.00	13.25	16.50	15.00
19th April -	31.00	56.50	260.00	270.00	52.00	13.50	16.50	14.50
26th April -	33.00	56.00	260.00	270.00	52.00	13.75	16.25	13.50
3rd May -	33.00	56.00	265.00	275.00	52.00	14.00	16.00	12.00
10th May -	32.00	55.00	262.50	272.50	52.00	13.50	17.00	12.00
17th May -	31.75	55.50	265.00	275.00	51.00	13.50	16.50	13.00
24th May -	32.75	55.00	255.00	265.00	50.00	13.12	16.50	12.50
31st May -	32.50	55.00	232.50	242.50	50.00	13.00	17.50	12.50
7th June -	32.50	55.00	210.00	220.00	50.00	13.00	17.50	11.50
14th June -	33.00	55.50	207.50	212.50	48.00	13.00	17.50	11.00
21st June -	34.00	56.50	205.00	215.00	48.00	13.00	17.25	12.50
28th June -	34.00	57.00	230.00	240.00	48.00	13.25	17.00	13.00

* F.O.B.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

* 1 kati = 1⅓ lb.

FEDERATION OF MALAYA
PRODUCTION OF PALM OIL AND KERNELS.
(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1953	1954	1953	1954
January	3,946	4,143	1,008	1,139
February	3,611	3,908	923	1,066
March	3,778	4,442	1,031	1,210
April	4,061	4,674	1,066	1,228
May	4,209	5,251	1,076	1,396
June	4,122	4,188	1,056	1,114
July	4,500		1,150	
August	3,980		1,000	
September	4,180		1,059	
October	4,083		1,063	
November	4,026		1,064	
December	4,602		1,173	
Total	49,098	(26,606)	12,669	(7,153)

In March, 51 estates (planted area 98,994 acres) were in production out of a total of 63 oil palm estates (planted area 109,127 acres).

MALAYAN AGRICULTURAL EXPORTS,
JANUARY-MARCH, 1954.

Product	Net Exports in Tons.			
	Year 1952	Year 1953	Jan.-March, 1953	Jan.-March, 1954
Arecanuts	10,467	11,580	3,465	1,879
Coconuts, fresh † ‡	94,024 †	88,315 †	13,595 †	19,650 †
Coconut oil ‡	65,113	60,779	9,398	19,146
Copra ‡	27,821 *	9,751 *	650 *	11,108 *
Copra cake	60,287 *	59,129 *	14,926 *	14,594 *
Gambier, all kinds	94 *	160 *	—	63
Palm Kernels	10,869	12,884 §	325	—
Palm Oil	46,008	47,579	9,993	11,597
Pineapples, canned	11,762	17,368	3,980	4,660
Rubber ¶	582,649 ¶	572,792 ¶	141,211 ¶	134,567 ¶
Sago,—flour	19,146	28,444	5,819	7,038
„ —pearl	5,553	5,896	1,609	1,238
„ —raw	24,835 *	27,246 *	6,664 *	9,100 *
Tapioca,—flake	39 *	128 *	1 *	236 *
„ —flour	4,075 *	7,362 *	1,253 *	1,928 *
„ —pearl	6,304	5,474	1,551	1,626
Derris	13 *	10	145	3
‡ Copra equivalent	79,868	90,781	14,893	20,397

¶ production (Federation of Malaya). † hundreds in number. * net imports.

§ oil palm fruits and kernels.

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1953	1954	1953	1954	1953	1954
January	31,354	30,278	23,514	19,014	54,868	49,292
February	23,423	25,354	19,140	17,913	42,563	43,267
March	26,898	24,556	16,882	17,452	43,780	42,008
April	26,155	24,749	16,805	15,339	42,960	40,088
May	27,820	27,572	17,679	18,585	45,499	46,157
June	27,202	26,873	17,024	16,236	44,226	43,109
July	30,188		20,400		50,588	
August	29,511		21,491		51,002	
September	28,934		18,394		47,328	
October	30,064		19,202		49,266	
November	28,985		19,250		48,235	
December	30,583		21,894		52,477	
Total	341,117	(159,382)	231,675	(104,539)	572,792	(263,921)
Total 1952	341,078		241,571		582,649	

This Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

FEDERATION OF MALAYA

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954
January	2,555	3,123	8,241	9.470	10,796	12,593	5,597	8,837	3,594	5,583
February	2,405	2,789	6,092	9,616	8,497	12,405	4,236	7,798	2,694	4,891
March	2,793	3,072	6,703	11,482	9,496	14,554	4,800	8,721	2,981	5,487
April	2,753	2,993	7,972	9,922	10,725	12,915	5,294	6,961	3,379	4,515
May	3,306	3,803	8,744	10,128	12,050	13,931	5,666	8,098	3,633	5,195
June	3,357	3,763	9,842	12,175	13,199	15,938	6,478	8,158	4,078	5,181
July	4,196		9,718		13,914		6,699		4,308	
August	4,070		11,179		15,249		7,935		5,048	
September	4,103		10,332		14,435		7,789		5,043	
October	3,890		11,998		15,888		8,808		5,607	
November	3,137		11,265		14,402		7,776		4,900	
December	3,565		9,580		13,145		8,381		5,157	
Total	40,130	(19,543)	111,666	(62,793)	151,796	(82,336)	79.459	(48,573)	50,422	(30,852)

Notes:—1. The above Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya. Minor changes in these figures are made by Registrar of Statistics in his quarterly Copra, Coconut Oil and Copra Cake Statistics.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

METEOROLOGICAL SUMMARY, MALAYA, JUNE, 1954.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	92.1	73.5	82.8	96.6	71.6	85.0	76.2			2.42	61.5	0.75	11	10				220.10	7.34	
Kuala Lumpur, Selangor	89.9	73.5	81.7	93.9	69.2	82.3	77.0			3.45	87.6	0.60	15	13	2	3				
Sitiawan, Perak	89.8	73.1	81.4	93.6	70.7	81.2	76.0	85.2	86.4	6.03	152.7	2.67	10	10	3			201.70	6.72	
Kuantan, Pahang	88.9	72.4	80.7	92.4	69.0	80.5	75.2	82.9		9.45	240.0	2.40	13	13	5			200.30	6.68	
Bayan Lepas, Penang	88.0	74.4	81.2	91.8	72.2	81.9	77.1			6.13	155.7	1.09	13	12	1			210.05	7.00	
Malacca	85.4	74.3	79.9	88.1	71.9	81.2	77.8			10.81	274.6	1.74	17	16	4		3	218.75	7.29	
Mersing, Johore	87.6	71.8	79.7	91.2	69.6	80.8	74.2			5.34	135.6	1.90	13	9	5			201.60	6.72	
Alor Star, Kedah	88.1	74.3	81.2	92.7	71.8	81.7	76.8			5.69	144.5	0.73	16	14				194.15	6.47	
Kota Bharu, Kelantan	88.5	74.1	81.3	91.0	71.0	85.7	77.8	85.1	87.1	10.39	263.9	2.82	15	12	6			224.00	7.47	
K. Trengganu, Trengganu	87.7	73.4	80.5	90.9	71.0	80.8	76.4			8.99	228.3	2.44	15	13	6	2		212.85	7.09	
Kallang Aerodrome (S'pore)	86.5	75.8	81.1	90.6	72.2	80.9	80.8			14.91	378.7	4.15	13	13	5			159.00	5.30	
HILL STATION.																				
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	73.8	52.7	63.3	77.0	41.0	69.0	58.0			4.37	110.0	1.00	15	13				174.25	5.81	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, JULY, 1954.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent.
	A. Max	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	90.7	71.8	81.3	96.3	67.3	81.4	74.0			5.85	148.6	1.55	14	13				196.55	6.34	
Kuala Lumpur, Selangor	89.3	72.4	80.9	93.9	69.8	81.6	74.8			5.47	138.9	1.52	14	11	2	10				
Sitiawan, Perak	88.5	71.6	80.1	91.3	67.8	80.6	74.0	83.5	85.3	6.98	177.3	2.78	13	10	3			193.20	6.23	
Kuantan, Pahang	88.0	71.2	79.6	91.3	69.0	81.8	73.8	82.1		12.22	310.4	2.00	16	15	5	3		194.45	6.27	
Bayan Lepas, Penang	86.3	73.5	79.9	89.1	70.6	77.0	76.6			9.59	243.6	2.06	14	12	1		1	192.35	6.20	
Malacca	84.7	73.5	79.1	87.8	70.0	81.2	76.0			9.44	239.8	3.38	19	16		1	3	214.90	6.93	
Mersing, Johore	86.9	70.9	78.9	89.6	68.2	82.1	72.5			8.86	225.0	1.87	16	14	3		1	196.10	6.33	
Alor Star, Kedah	87.4	72.9	80.1	91.2	69.9	79.3	75.4			11.70	297.2	3.55	22	19	1			206.05	6.65	
Kota Bharu, Kelantan	87.6	73.5	80.5	89.9	71.1	83.4	76.0	84.2	86.4	12.66	321.6	2.22	18	15	6	1		220.40	7.11	
K. Trengganu, Trengganu	87.7	72.6	80.1	90.9	69.4	83.7	74.9			4.96	126.0	1.31	14	10	3		1	211.35	7.14	
Kallang Aerodrome (S'pore)	86.3	76.1	81.2	90.2	73.0	81.7	80.0			2.89	73.4	0.68	16	11	2			166.55	5.37	
HILL STATION.																				
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	72.9	52.7	62.8	77.0	44.0	67.0	57.0			8.02	203.7	2.04	20	18				160.40	5.17	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, AUGUST, 1954.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	91.3	72.5	81.9	94.8	70.2	82.6	75.6			6.63	168.4	3.82	14	9	1			202.85	6.54	
Kuala Lumpur, Selangor	90.0	73.1	81.5	94.8	71.1	85.8	76.8			3.33	84.6	1.23	9	8	4	5				
Sitiawan, Perak	88.8	72.4	80.6	92.0	69.5	81.2	75.5	84.3	85.2	5.10	129.5	1.37	9	9	4			207.75	6.70	
Kuantan, Pahang	89.2	72.1	80.7	91.6	69.6	85.9	75.2	82.4		7.79	197.9	1.73	14	12	6	4		213.10	6.87	
Bayan Lepas, Penang	87.5	74.2	80.9	89.7	71.3	83.5	77.0			3.63	92.2	1.10	15	12			2	201.40	6.50	
Malacca	84.7	73.9	79.3	86.7	69.8	81.8	77.2			7.47	189.7	1.41	16	15			5	205.25	6.62	
Mersing, Johore	87.1	71.3	79.2	89.5	69.5	83.6	74.0			4.32	109.7	1.99	16	14	4			195.60	6.31	
Alor Star, Kedah	87.4	73.6	80.5	91.4	70.7	77.2	76.8			8.89	225.8	1.87	19	15				212.30	6.85	
Kota Bharu, Kelantan	88.1	73.9	81.0	90.5	72.0	84.9	77.0	85.6	86.8	4.01	101.9	0.91	13	12	7	1		226.75	7.31	
K. Trengganu, Trengganu	87.4	72.6	80.0	89.3	69.0	84.7	74.9			8.32	211.3	2.98	10	10	2			210.25	6.78	
Kallang Aerodrome (S'pore)	86.2	75.2	80.7	88.8	71.0	81.2	79.7			14.25	362.0	3.86	16	15	7			172.15	5.55	
HILL STATION.																				
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	72.5	53.1	62.8	77.0	48.0	68.0	58.0			4.78	121.4	1.10	16	15				141.05	4.70	

Compiled from Returns supplied by the Malayan Meteorological Service.